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Julia Vedom et Huhua Cao

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Julia VEDOM

University of Ottawa
Purreplain@gmail.com

Huhua CAO

University of Ottawa
Department of Geography
60 University Street (030)
Simard Hall
Ottawa ON
K1N 6N5 Canada
caohuhua@uottawa.ca

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INTRODUCTION

Equity in social welfare has long played a major role in shaping China's national policies [Liu *et al*., 2002]. However, continued pursuit of the market-oriented reforms introduced in China in the late 1970s has resulted in increasing urban-rural and intra and inter-regional socioeconomic disparities [Zhao, 2006]. This raised multiple causes for concern from an equity perspective, suggesting that trends should be closely monitored. As a result, during the last decades the analysis of health care-related issues in China has received substantial attention. Our research will attempt to extend the rather sparse literature assessing changes in access to health care stemming from economic reforms in China by pursuing two specific questions herein:

1) how have geographic and financial disparities in access to clinics and hospitals changed during the 1989-2004 period? And
2) to what extent did demographic, socioeconomic and geographic factors affect access to health facilities in 2004? Focusing specifically on geospatial analysis, using the China Health and Nutrition Survey (CHNS), this study tracks the changes in accessibility of health care at the household level across socioeconomic groups in nine provinces of China over the 1989-2004 period. By means of a multivariate analysis this research seeks to contribute to the understanding of causes in health care access disparities in China summarizing and critically assessing existing English-language literature on the subject.

Accessibility and health risk

Health risk is defined as "the probability that an event will occur, e.g. that an individual will become ill of die within a stated period of time or by certain age." [Porta M. as cited in Friis 2010, p. 18]. Literature suggests that accessibility of health care is associated with increased health risks related to occupational safety [Nuwayhid, 2004], infection [Li, Zhang, Stanton *et al*., 2007; Wu, Rotheram-Borus, Guan *et al*., 2007], reproductive health [Feng, Ren, Shaokang *et al*., 2005], mental health [Li, Wang, Jiang *et al*., 2007] and health behaviours [Li, Zhang, Stanton *et al*., 2007]. Low capacity to pay medical bills, and resulting unsatisfactory health

outcomes have also been described by other researchers [Braveman, 2006; Fiscella and Williams, 2004]. Similarly, earlier studies have noted the potential societal and health consequences resulting from the increasing socio-economic disparities [Adler and Newman, 2002]. The social, economic, cultural and policy context determine the accessibility of health care and for this reason are known to have a certain degree of influence on the health risks of communities. Access to health care in China, as a determinant of health, became unequally distributed geographically (between coastal-inland, and urban-rural settings) as well as among social groups, in relation to financial access to health care and insurance coverage (see discussion section), in turn putting the disadvantaged communities in especially vulnerable position by increasing their health risks [Ding & Zhu, 2007].

Accessibility of health care in China

While the importance of accessibility is well understood in the literature, there is little agreement on how to measure, or even define it. Empirical studies relevant to health care access in China can be somewhat arbitrarily grouped into three main categories based on the criteria used for the measurement of access:

1) utilization of health services,
2) availability of health insurance, and
3) studies creating an index to evaluate accessibility of health services.

While this paper will examine accessibility and health risk using indices, it should be noted that a significant amount of literature exists in the first two categories. Though they will not be dealt with extensively here, studies examining use of health services have found significant and apparently non-random reductions in health care use since the introduction of economic reforms [see Bloom, 2001; Mao, 2006; Wagstaff & Yu, 2007; Liu, 2004; and Liu, 2007]. In contrast, [Henderson *et al*. 1998] concluded, using CHNS data, that between 1989 and 1993, health care was widely accessible and there was no evidence of declining use of services over this period. Possible explanations for this may be the earlier time period covered in the study or the self-reported nature of the data. Not only have studies found an overall decline in health care use, but the growing disparities between urban-rural health care utilization rates have also been documented [see Liu *et al*., 1999; Li *et al*., 2007; and Meng, 2007]. A number of qualitative studies have attempted to find the underlying causes of reported utilization practices, identifying high costs [Hong *et al*., 2006; Liu, 2004; and Wang, Tong and Lo, 2007]), lack of insurance coverage and exacting work schedules [Hong *et al*., 2006] as barriers to accessing health care.

Health insurance, another commonly used proxy for the measurement of access to health care, is often cited in the literature as being an important policy instrument with a capacity to improve access to health services [Ding & Zhu, 2007]. Since the introduction of economic reforms in China, a number of researchers have studied the effects of reforms on disparities in insurance coverage with somewhat inconsistent findings. For the most part, an alarming decline of insurance coverage as a result of reforms has been documented [Henderson *et al*., 1998; Yip & Hsiao, 2008].

There are a growing number of studies suggesting that while there was an overall decline in insurance coverage since the reforms, these reforms nonetheless had an important positive effect on equity of coverage [Akin, Dow and Lance, 2005; Liu *et al*., 2002]. Although insurance coverage generally acts as a facilitator of access, Wagstaff and Yu (2007) have found that the World Bank's project in Gansu province, which among other goals strived towards commune-based insurance scheme resurrection, had a negative effect on the use of health services and thus did not improve the access to care. Moreover, a recent study by Wagstaff & Lindelow found that availability of health insurance increases the risk of high and catastrophic spending by encouraging people to seek care when sick and to seek care from higher-level providers [Wagstaff & Lindelow, 2008].

While the utilization of health care and the availability of health insurance are common proxies used for the measurement of access to health care, they are single-variable indicators of access and, consequently, do not reflect the complex nature of the access concept. In order to closely reflect the

concept, access indices can be used. The advantage of these measures lies in a possibility of inclusion of different types of access indicators, creating a complex representative indicator. Although indices are commonly used to study accessibility, to the best of our knowledge there is only one study published in English using this approach to examine health care access in China. In their 2005 study, Akin, Dow and Loh evaluated the changes in access to health care at the community level between 1989 and 1997 using the CHNS data. They built an index comprised of 5 access measures: distance to closest health facility, service charges, time spent waiting to be seen by a health professional, availability of a doctor trained in Western medicine, and availability of basic medicine at the facility. While they call it an index they nonetheless run separate multivariate regressions for each of the access indicators without successfully building a true index. The findings of this study suggest uneven changes to access indicators.

Research on access to health care in China has largely focused on health insurance and use of services, with little empirical evidence on urban-rural, provincial and regional disparities. Meanwhile, the research increasingly suggests that geographic location may influence a patient's chance of receiving care [Liu *et al*., 2007]. Along with China's polarized development during the last three decades this demonstrates the need for a geographic focus. Since the reforms of 1978, PRC has been experiencing incredibly uneven economic development that has affected all facets of social, economic and political conditions. In fact, it is impossible to study contemporary China without considering its inequalities. Geographic and socio-economic disparities need to be understood and eliminated for the achievement of the government's goal of creating a harmonious society. Unlike previous studies, this research employs a framework that takes into consideration China's unique context and is designed to highlight geographic disparities in accessibility of care. Figure 1 presents the conceptual framework used for this study that was adapted from Aday and Andersen (1974). This framework is the dominant and the most applied theory of health care access that has been used widely as a framework for health care use studies of general populations as well as of minorities, low income, and other vulnerable groups [Andersen, 1995]. While the original framework includes 5 main components we add a 6th to underline the importance of location in China since the characteristics of the population, the characteristics of the delivery system, the health policy, consumer satisfaction and the use of services are a function of location. Due to the lack of data required to produce more comprehensive indices, we focus on the effect of health delivery system and population characteristics on the access index composed of four variables falling in geographic and financial dimensions: travel time, waiting time, travel cost and service charges.

DATA AND METHODS

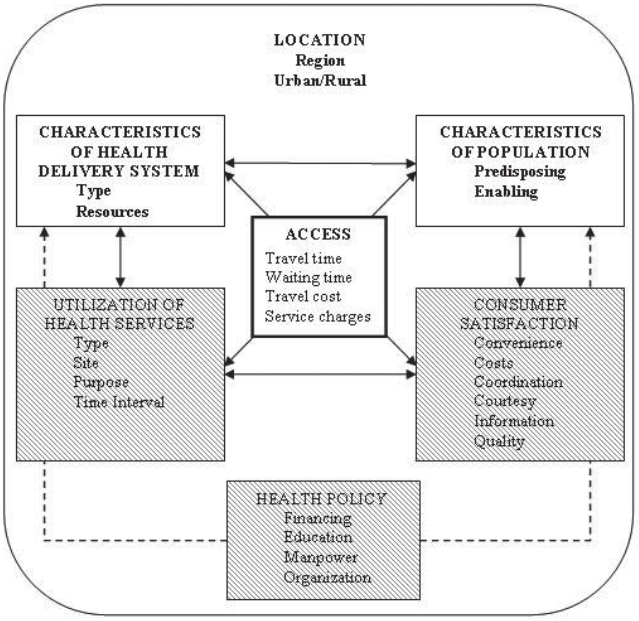
Data

The data used for this project come primarily from the UNC Carolina Population Centre CHNS[1] and from the *China Statistical Yearbook 2005*. The CHNS is an ongoing international collaboration between the University of North Carolina, the National Institute of Nutrition and Food Safety of the United States, and the Chinese Center for Disease Control and Prevention. This is a unique longitudinal publicly available dataset that covers 9 provinces[2] of China that vary considerably in terms of geography, economic development, infrastructure, and health

[1] UNC Carolina Population Centre (2008) *Chinese Health and Nutrition Survey (CHNS)* http://www.cpc.unc.edu/projects/china

[2] Originally, only 8 provinces participated in the survey (Liaoning, Shandong, Jiangsu, Henan, Hubei, Hunan, Guangxi, and Guizhou). Later, however, the 9th province, Heilongjiang, was added to the survey design. These 9 provinces are located in 3 regions of China as defined by the official definition of the *Chinese Statistical Yearbook*: Eastern region (Liaoning, Shandong, Jiangsu), 4 provinces in the Central China (Heilongjiang, Henan, Hubei, Hunan) and 2 in the Western region (Guangxi, Guizhou).

Figure 1. Conceptual framework for the study of access to health care



Modified from the study of access proposed by Aday and Andersen, 1974.

indicators. Figure 2 presents the map of the CHNS sample distribution. Since the first round of the CHNS data in 1989, there were six additional panels in 1991, 1993, 1997, 2000, 2004, and 2006. The samples in the survey are drawn using a multistage weighted random cluster process. In each province 4 counties were selected randomly for the survey. In addition, whenever possible, the provincial capital and a lower income city were also chosen[3]. The CHNS survey includes a health services section containing detailed information on insurance coverage, medical providers, and health facilities that the household might use under selected circumstances. The impacts of health care and health behaviour are measured by changes in sets of household and individual economic, demographic, and social factors.

The present analysis uses three years of data: 1989, the baseline year of the survey; 2004, the most recent complete year available; and, 1997, the intermediate year. All data came from longitudinal datasets, except for the income data, which were only available in cross-sectional format. Since the data needed for this research were contained in multiple files they were first sorted based on the household ID and then merged based on the household ID and the respondent's ID. Only responses of the heads of households living in the house were kept for the analysis for two reasons: because it is culturally accepted in China that the head of the household is the most informed member of the family; and, also for assurance of comparability of the answers. Household is thus the unit of analysis. After excluding all missing and incomplete cases, samples of 1811 households in 1989, 3071 households in 1997 and 2904 households in 2004 were obtained.

Defining accessibility and examining its evolution between 1989 and 2004

The current study examines the evolution of access to two types of facilities: clinics and hospitals. Clinics comprise village clinics, private clinics, work unit clinics, town family planning services and other types of clinics. Hospitals include town hospitals, county maternal and child hospitals, county hospitals, city maternal and child hospitals, city hospitals, workers' hospitals and other types of hospitals. It is important to note that

[3] See Henderson *et al*. (1995) for more detail on the sampling process and description of the data.

Figure 2. CHNS Sample Distribution

Julia Vedom.
Projection : Regional Conformal Projection (China).
(Softwear : ArcGIS 9.0)

the Chinese health care system equally recognizes the Western medicine and the traditional Chinese medicine. For this reason, health care facilities in China always have both departments available at the same facility.

Accessibility to health care is defined in terms of geographic and financial access at the household level and summarized into an index using four continuous and equally weighted variables related to:

1) physical distance: travel time (the time it takes to travel one way by bicycle from the respondent's home to the facility used, measured in minutes) and waiting time (the time it takes to see a doctor or health care professional, measured in minutes); and
2) financial indicators: cost of travel (the cost of travel one way from the respondent's home to the facility used, measured in Yuan), and service charges (the average cost of cold or flu treatment, measured in Yuan). Both travel time and waiting time measure the physical distance between the patient and the physician. Travel cost and service charges, on the other hand, measure financial barriers faced by the patient. These four variables come from the *Accessibility of health care and medical services* section of the CHNS household survey and are self-reported values. All cases that had any of the access indicators missing were excluded from the analysis.

Since there are substantial differences in physical and financial indicators among clinics and hospitals [Akin *et al*., 2005], the differences pertaining to the type of facility used were considered in the calculation of the accessibility index. First, the mean values were calculated for each of the indicators

considering the type of facility used. According to the gravity model there is an inverse relationship between distance and frequency of utilization of service, such that the utilization of facilities tends to decline as the distance between the user and the facility increases [Morrill, 1974]. For this reason, if the indicator measure was lower than the average physical or financial indicator value, then 1 was assigned. If it was higher, 0 was coded. The zero-based index was then calculated as a simple sum of the 4 indices. Consequently, the higher the index, the better is the access to health services (4 being the best and 0 being the worst). It is important to note that an index of 4 is not 4 times better than the index of 1; it simply implies comparatively better access without quantifying the accessibility gap. Index created for this study is not weighted and substantially less complex than those used in previous studies [Iversen & Kopperud, 2005; Wang and Lou, 2005].

Central tendency statistics were produced to describe the evolution of health care access from 1989 to 2004, providing a general picture of changes in the access over the years.

Examining the determinants of access to clinics and hospitals

To examine factors affecting access to clinics and hospitals at urban and rural levels, multivariate linear regression (least squares) analysis was performed on the most recent data available (2004). The access index was regressed on the following predictor variables.

The *demographic characteristics* (gender, minority (non Han), marital status and education) of the head of the household were entered in the first model, the *financial attributes* (availability of health insurance, per capita household income and whether the facility used is a referral facility for the work unit of the head of the household) were entered together with the demographic factors in the second block. Finally, *geographic factors* (method of travel to the facility, region of residence and availability of health care facilities) were added to the demographic and financial attributes and entered all together. The availability of health care was defined by the number of health care facilities per capita in the province of residence of the household. The predictor variables were entered in three sequential models (blocks) using the "enter" method and regression models were stratified by location (urban/rural) and conducted separately for hospitals and clinics. Analyses were conducted using SPSS v.16.

RESULTS

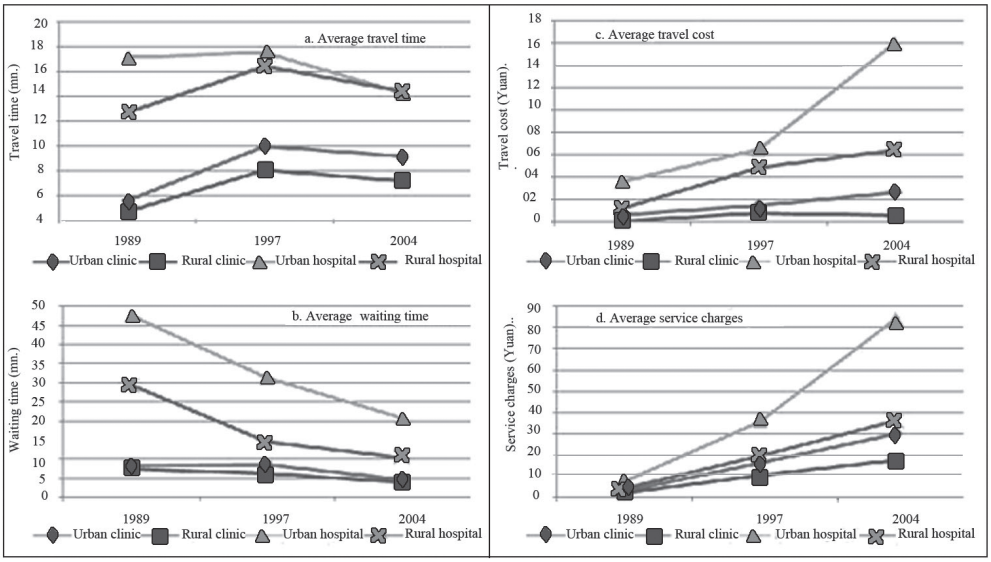
Descriptive Analysis: Evolution of Health Care Access from 1989-2004

Geographic access

Figure 3a and 3b present the changes that occurred from 1989 to 2004 in geographic access indicators. During the 15 years the travel time has seen some important changes. First, there was an increase in travel times, for both hospitals and particularly clinics from 1989 to 1997 and then a decrease in travel time by 2004. Most of the improvements in travel time occurred in urban hospitals where it decreased on average from 17 to 14 minutes. Meanwhile travel time to clinics, particularly in urban areas increased significantly from 5.6 minutes in 1989, to 9.1 minutes in 2004. Both rural clinics and rural hospitals also have seen increases in travel time, but not as pronounced as were recorded for urban hospitals. Nonetheless, travel time to clinics remains about two times lower than travel time to hospitals. Hospitals in urban and rural areas are equally accessible in terms of travel time, while there is a small urban-rural gap in travel time to clinics, favoring rural residents.

The second geographic indicator, average waiting time, has decreased consistently for both types of facilities with significant reductions in hospitals. In fact, in rural hospitals waiting times decreased from an average of almost 30 minutes to 10.5 minutes. Similarly, waiting times in urban hospitals have seen much improvement. Nonetheless, with an average wait of 20.8 minutes, urban hospitals remain the least accessible facilities in

Figure 3. Changes in geographic and financial indicators of accessibility to health care in China between 1989 and 2004



Source : CHNS 1989, 1997 and 2004.

terms of waiting time, compared to hospitals in rural areas and particularly to clinics where, on average, patients reportedly wait only 4 minutes.

Financial access

Figure 3c and 3d present the changes in financial indicators of access to health care. Over the study period, both financial indicators of access have seen substantial increases over the years. Travel costs increased considerably only for urban hospitals increasing 4 times over the 15 years. The urban-rural gap in travel costs among the facilities has also grown over the years with urban facilities, especially hospitals that are generally associated with higher costs. Overall, costs associated with travelling to health care facilities remain very low. Mostly, people prefer walking or biking to the facilities, which helps to keep the travel costs minimal.

Service charges have increased at a faster rate. Rural areas have seen prices for a treatment of flu or cold increase 7.5-8 times, while in urban areas service charges increased 9.5-11 times. Hospitals remain more expensive than clinics, charging on average, 2.5 times more for the same service. In fact the urban-rural gap has increased dramatically over the years. In 2004, for example, the cost of an average treatment of a cold in the rural clinic was 17.4 Yuan, while urban hospitals were charging 84.2 Yuan (or almost 5 times higher) for similar treatment.

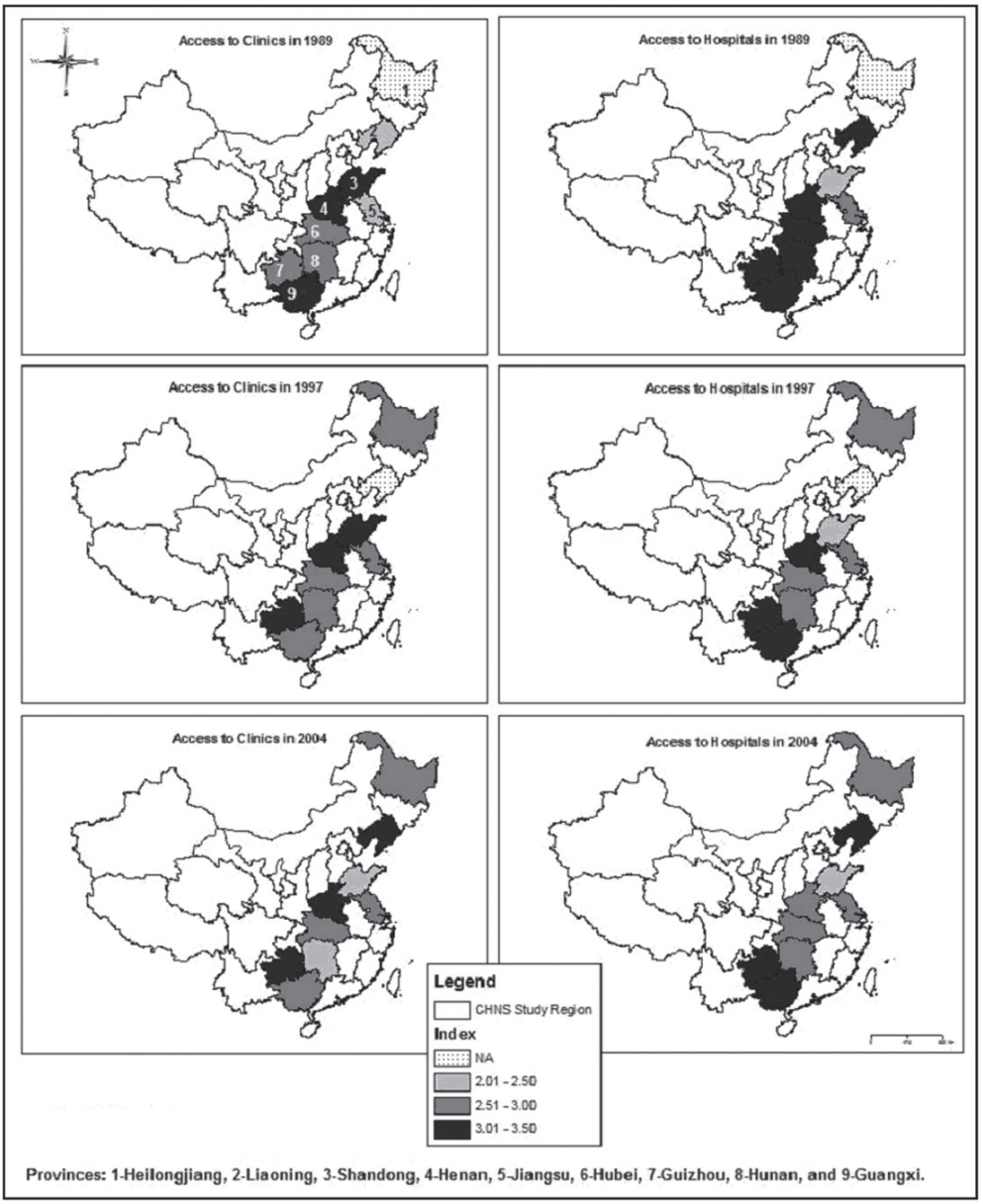
On the whole, we find clinics to be more accessible than hospitals in terms of geographic and financial indicators in both urban and rural areas. Also, in 2004, there were 3.5 times more clinics than hospitals. These facilities however differ significantly in size and quality (see discussion on section hospital vs clinics).

Multivariate Analysis: factors associated with access to health care

Figure 4 summarizes the changes in the access index from 1989 to 2004. Overall, the access index to clinics has changed little, but we see a definite decline in the hospital accessibility index over the study period, particularly noticeable in the central region (Heilongjiang, Hubei, Hunan and Henan provinces) with the access index gradually becoming lower and lower. Interestingly, access to hospitals has always been much higher in the western region (Guangxi and Guizhou), while hospitals were consistently the least accessible in one of the eastern provinces, Shandong province. The changes in the clinic access indices over time are mixed with no noticeable trends, with the exception

of Henan province, where access to clinics is generally found to be better. Although the overall index values have remained more or less stable, the socio-economic, financial and geographic determinants have undoubtedly changed.

Figure 4. Access index in clinics and hospitals in China from 1989 to 2004



Julia Vedom.
Source : CHNS 1989, 1998 and 2004.
Projection : Regional Conformal Projection (China)
(Softwear : ArcGIS 9.0)

Determinants of access to health care

While the accessibility of health care facilities varies greatly between clinics and hospitals, the factors affecting it are similar. Access is mostly affected by geographic factors, such as the method of travel to the facility, the location of the facility, and the availability of infrastructure in the province. Multiple regression analysis results are contained in Table 1. Standardized coefficient, Beta, values reflect the weight associated with the partial correlation coefficients. They represent the relationship between the independent variable in question and the dependent variable with the influence of the other predictor variables held constant. The individual contributions of each of the models are presented in Table 2. R^2 change indicates the change in the proportion of variance accounted for in the dependent variable by each of the blocks entered. The higher the R^2 change value, the greater its explanatory power.

Table 1. Regression results of determinants of access to health care in China

Variable		HOSPITAL		CLINIC	
		Urban (n=552)	Rural (n=874)	Urban (n=296)	Rural (n=1182)
	R	0.509***	0.338***	0.443***	0.279***
	R square	0.259	0.114	0.196	0.077
		Beta	Beta	Beta	Beta
Demographic	Gender (female)	0.004	0.014	-0.045	-0.092**
	Minority	0.024	0.009	0.097	0.140***
	Marital Status (married)	-0.059	0.047	-0.017	-0.097***
	Education	-0.013	0.083**	-0.058	0.005
Financial	Health insurance	-0.099**	-0.109***	-0.060	-0.181***
	Income (per capita)	0.017	0.044	-0.030	0.033
	Referral facility for work unit	0.059	0.059*	0.023	-0.061**
Geographic	Travel method	-0.335***	-0.205***	-0.273***	-0.126***
	Region	0.270***	0.201***	0.242***	-0.145***
	Infrastructure	0.282***	0.221***	0.135**	-0.153***

*** significant at p=0.01, **significant at p=0.05, * significant at p=0.1.

Determinants of access to hospitals

Four of ten independent variables (health insurance, travel method, region, and infrastructure) used to explain the accessibility of urban hospitals contributed significantly to the analysis. The predictor variables cumulatively explain 26% of the variance in the dependent variable (access to urban hospitals) significant at $p<0.001$. The geographic factors account for 21.6% of this variance. The method of travel (Beta=-0.335) is the most important predictor of access to hospitals in urban areas. It contributes negatively, meaning that those who are able to walk to clinics in urban areas enjoy better access than those who rely on other means of transportation. The higher availability of hospitals (second predictor, Beta=0.282) and the region of residence (third predictor, Beta=0.270) are positively correlated with the outcome, leading to better access in the West of the nation and in provinces with denser infrastructure. Demographic factors do not contribute significantly to the model, but one of the financial aspects, possession of health insurance, is negatively related to the dependent variable. Insured patients have significantly lower access to hospitals in urban areas than uninsured ones.

In the case of rural hospitals, again the geographic predictors account for the largest proportion of the variance (7.9% of 11.4% explained by all 10 predictors together). Rural residents of the eastern region and those who have to rely on alternative to walking means of transportation have lower access

Table 2. Regression model summary

		Hospital			Clinic		
Block	**Location**	**R**	**R^2**	**R^2 change**	**R**	**R^2**	**R^2 change**
1*		0.113	0.013	0.013	0.262	0.069	0.069
2	**Urban**	0.196	0.043	0.030	0.276	0.076	0.007
3		0.509	0.259	0.216	0.443	0.196	0.119
1		0.123	0.015	0.015	0.132	0.017	0.017
2	**Rural**	0.188	0.035	0.020	0.203	0.041	0.023
3		0.338	0.114	0.079	0.279	0.078	0.037

*Note : Block1 includes demographic factors only, Block 2 includes both demographic and financial factors; and Block 3 includes demographic, financial and geographic factors.

to hospitals. Higher availability of hospitals per 10,000 population in the province of residence is the most important access determinant for rural hospitals (Beta=0.221), leading to better access to health care resources. Travel method (Beta=-0.205) and region (Beta=0.201) are also significantly correlated with the outcome. Again, among rural residents, those who were able to walk to health care facilities and those residing in western provinces, were the most likely to enjoy better access to rural hospitals. As in urban hospitals, insured patients have worse access to hospitals than uninsured ones. It is important to note that education affects the access to hospitals in rural areas in a positive way (Beta=0.083). In fact, it is the only area where the patients' level of education is significantly related to the outcome variable. Individuals with higher levels of completed education tend to enjoy better access than those who have lower educational attainments.

Determinants of access to clinics

There is a comparatively strong relationship between our 10 predictor variables and access to clinics within urban areas, R=0.443 and R^2=0.196 with the overall model significant at p<0,001. The accessibility to clinics is predominantly affected by geographic factors, as seen by the fact that the change in R^2 (0.119) is the largest when this group is entered (Table 2). Three geographic variables contribute significantly to the analysis. Both the region of residence and the density of health care infrastructure are positively related to the access measure, implying that access is better in the central and western region's provinces where there is higher availability of health care facilities. Demographic and financial measures do not seem to be significantly related to the access of clinics in urban areas.

The association between the predictor variables and the access is less strong in rural clinics, with R=0.279. Interestingly, the geographic factors contribute less in the rural clinic model than in the case of urban clinic model (R^2 change=0.037). Nonetheless, they remain the most influential predictor group in the equation, accounting for most of the variance in the dependent variable. All geographic variables contribute negatively, meaning that residents of the East and those who are able to walk to facilities enjoy better access to rural clinics. Surprisingly, greater availability of clinics in rural areas is associated with reduced access. Contrary to urban clinic model, here the financial and socio-cultural characteristics are significant. Financial factors such as availability of health insurance and referral from the work unit, explaining 2.3% of variance in access, affect the access to rural clinics negatively. Minority status also plays an important role facilitating the access to clinics in rural areas (Beta=0.140). Moreover, gender and marital status affect the access to clinics in rural areas, with single male household heads having better access than their married female counterparts.

Overall the correlations between the predictors and the outcome measure are slightly stronger for hospitals than they are for clinics. Access to both clinics and hospitals is primarily affected by geographic measures

although the relative importance of the predictors differs. In urban hospitals and clinics the method of travel is the most important predictor of access, while in rural hospitals it is the density of infrastructure, and in rural clinics it is the availability of health insurance.

Our results suggest that for the most part, access to health care is higher in the western region for all types of facilities except for rural clinics. This is contrary to findings of previous studies, suggesting that the situation is considerably worse in this region. Since we did not compare the actual utilization rates of the facilities we can not conclude that doctor visits and hospitalization rates are also higher in the western region.

Finally, demographic factors (gender, marital status, ethnicity, etc.) or factors predisposing people to use health care are generally found to be related to the use of care and thus to the access to health services [Aday & Andersen, 1974]. In our study however, demographic factors were found to be significantly related to the outcome variable only in rural clinics. Although statistical significance might be a result of a large number of cases, since the number of people using rural clinics is substantially higher than the number of users of other facilities. It is also possible that in traditional rural settings gender and marital status differences are still a lot more important than in modern egalitarian urban areas.

DISCUSSION

Spatial inequalities and access to health care

The significant impact of geographic factors on the access to health care found in our study is hardly surprising. During the last three decades China has been experiencing considerable economic growth, as well as widening geographic (coastal-inland), sectoral (urban-rural), and social (majority-minority) disparities [Chang, 2002; Lin, 2002]. Following the economic reforms in the late 1970s, China has clearly emphasized the development of urban and coastal areas, believing that these regions would stimulate the prosperity of the whole county. Incredibly uneven economic development in China since the reforms of 1978 has resulted in substantial differences in health expenditures between the poorest rural areas of the West and developed eastern areas of China. As a result, health risks are significantly higher in vulnerable and disadvantaged populations [Adler and Newman, 2002]. A number of previous studies emphasized the pronounced urban-rural income disparities and differences in health risks associated with mental health [Li, Wang, Jiang *et al*., 2007] health insurance coverage inequalities [Liu *et al*., 2002], striking gaps in infant mortality ratios, at least twice higher tuberculosis prevalence rates in rural areas [Zhao, 2006], urban-rural differences in health status and in the use of facilities [Henderson *et al*., 1998], differences in the availability of hospital personnel, beds and bed occupancy rates [Mao, 2006; Meng, 2007], and disparities in costs of health care provision [Hougaard, Osterdal, & Yu, 2008]. Such unanimity among geographic studies in China reporting striking disparities between urban and rural households demonstrates the inherent importance of geographic factors in the analysis of access to health care in China.

The quality of care was not assessed in this study, but facilities vary greatly in terms of size and services offered. The facilities in the western region are comparable with the facilities in the rural areas, where hospitals have considerably fewer beds and qualified medical personnel on staff. While urban hospitals have on average 128.5 beds and 170.4 employees, rural hospitals have only 16.1 beds and 24.8 staff members [China Statistical Yearbook, 2005]. In 2004, the urban-rural ratio in hospital beds per 10,000 of population was 2.2 and 2 in health care personnel employed [China Statistical Yearbook, 2005]. Not only are there two times less medical professionals in rural areas, but the quality of their training is also considerably lower in the under-developed poor areas [Meng, 2007]. In 2003, a study of 46 poor counties by Wang *et al*., found that 70% of village doctors did not have

any formal medical education and have received on average 20 hours of training [Eggleston *et al*., 2008]. Consequently, in under-developed areas, patients' level of wealth and education is a critical predictor of the quality of health care services that patients receive, because those who are aware of quality differences "substitute the benefits of choice for the inconvenience of a longer journey" [Haynes, Lovett, & Suennenberg, 2003, p. 1733].

Although the urban-rural disparities have been widely documented and became a center of access equity discussions in recent years, studies of regional disparities in health care access remain very limited, concentrating on particular aspects of access (e.g. availability of health insurance). Such paucity of emphasis on regional disparities is somewhat surprising considering the historical developments in the PRC since the economic reforms of the late 1970s. Provincial and particularly regional inequalities in China have been increasing consistently since 1980s as a result of government programs favouring the development of the eastern region. To the best of our knowledge, there have been only a handful of studies taking into account the importance of regional disparities in health care in China. Their findings however point at the importance of regionalism in China. Alarming differences were found in both male and female infant mortality rates between coastal and inland China; although health risks were not compared in these areas, the literature suggests that inland areas are subject to higher risks leading to lower health status of the population. Liu *et al*. (2007) report regional differences in physician visits, hospitalization rates, and insurance coverage; considering the polarized development of geographic regions in China, it becomes evident that more health care research is needed in this area. Incorporating the regional aspect into the analysis, our study fills an important gap, contributing both to the literature on regional disparities and health care literature.

Income and access to health care

Our findings confirm substantial increases in service charges in both hospitals and clinics between 1989 and 2004, but using the multivariate analysis, surprisingly, we found no significant correlation between per capita income and the access to health care either in urban or rural areas. Since regression results present the partial correlation coefficients it is possible that the role of per capita income, although undoubtedly important, is relatively less important compared to the role of the region where the income is earned. As was mentioned in the previous section, unbalanced development and pronounced regional disparities are such a prominent phenomenon in China that everything becomes a function of a region and urban-rural sector of residence[4]. Although the accessibility gap between the different types of facilities has decreased between 1989 and 2004 in terms of travel and waiting times, the gap in financial accessibility has escalated over the years, making urban hospitals the least accessible facilities. These findings are consistent with the research of Akin *et al*. (2005) who found a decline in access to hospitals between 1989 and 1997 compensated by an improved access to clinics. As a result of the government-imposed price regulation system, publicly owned hospitals have a poor revenue-generating capacity unless they earn profits from the use of new drugs, tests and high-tech care, keeping the hospital charges high. In rural areas, however, it is estimated that one third of drugs dispensed are counterfeit, which simultaneously keeps charges low and profits high [Mao, 2006].

The link between price and demand for health care has been widely documented. Generally, utilization of medical care tends to decrease with an increase in price of services. Due to a rapid health care inflation triggered by the economic and health care reforms, the share of out-of-pocket expenses paid by the patients has been increasing steadily from 16% of overall health care expenditures in 1980, to 38% in 1988, and to 61% in 2001. Higher costs can be partially explained by general inflation and aging

[4] Another possible explanation is related to the nature of the variables used. The per capita income variable is a combined variable that is calculated based on the earned and unearned income information, taking into account the income from subsidies and bonuses, both at the individual and household levels.

population. However, the outcomes of hospital financial reforms, such as abusive usage of more expensive high-technology and over prescription of drugs and services, accounts for a progressively larger share of personal health care costs. These increases in health-related expenses along with the reductions in health insurance coverage caused greater gaps in access to health services particularly among urban-rural residents [Liu, 2004; Liu *et al*., 2002]. Significant reductions in health care use and visible declines in bed occupancy are well documented [Bloom, 2001; Liu, 2004; Mao, 2006; Wagstaff & Yu, 2007]. Analyzing the Chinese Ministry of Health 2003 data, Hougaard (2008) found that the ratio between people who reported illness but did not seek formal care for financial reasons increased from 36.4% in 1993 to 48.9% in 2003 and was particularly high in low-income rural areas (63.7% in 1998 and 75.4% in 2003). Moreover, Liu (2004) found that on average, 45% of discharges from inpatient care in rural areas are initiated against medical advice and in almost 80% of cases for financial reasons. In fact, another study by Liu *et al*., (2007) reported that in 2003 physician visits were lower in poor less-developed regions (mid and western China) and only 43% of respondents saw a doctor when they were ill, while 32.2% relied on self-treatment and 15.8% had no treatment at all. People rely on self-treatment or ignore health issues for as long as they can, in hopes of avoiding the related expenses, increasing their health risks. Although the health-related charges are lower in less developed areas, such as in the West of the country, they nonetheless place a comparatively heavier burden on the shoulders of the western rural residents. Mao (2006) concluded that in 2003 the average hospital admission fee was equivalent to 27.9% of the average per capita urban wage, while 149.1% of the average rural wage. Health insurance is yet another financial factor often cited in access literature as a policy instrument with a capacity to improve the use of health services rendering the access to health care more equitable [Ding & Zhu, 2007]. Although, some studies found that the lack of health care coverage prevents people from getting the needed medical care [Zhao, 2006], others suggest that the availability of coverage encourages people to seek care when sick and to seek care from higher-level providers, in turn increasing the risk of high and catastrophic spending [Wagstaff & Lindelow, 2008]. Also, the majority of people who purchase insurance coverage are sick and are predisposed to having higher-than-average out-of-pocket payments. Since our accessibility index is based on average health charges, higher than average health expenditures are interpreted as lower access, which explains why residents of the eastern region appear to have worse access than those who live in the West of the country. While interpreting these results we should keep in mind that insurance schemes are also very different in nature. Health insurance schemes in rural areas are largely (80%) funded by personal contributions, while urban residents are required to contribute considerably smaller shares ranging from 0 to 25% depending on the type of the employment sector. The coverage schemes vary considerably not only between the employment sectors, but also between the urban and rural areas, as well as between provinces. The financial aspect is thus still an important barrier restricting access to health care among the poor and the residents of less developed western provinces.

CONCLUSION

This study has examined the access to health care facilities and evaluated the effects of demographic, financial and geographic factors on the access to health care services, extending the literature assessing the changes in access to care. Our work quantified the access to health care, focusing more on geographic factors than earlier access literature [Akin *et al*., 2005]. There is no previous published research in English that has directly examined the factors affecting the accessibility of health care facilities in China. Although, the determinants of the use of health care facilities have been studied earlier

[Henderson *et al*., 1998], to the best of our knowledge, there has been no research on determinants of access. We find a pronounced correlation between the geographic factors (method of travel, region, and availability of infrastructure in the province of residence) and the quality of access received. This finding is supported by Liu *et al*. (2006) who found that in 2003 for 73% of rural and for 46% of urban residents proximity was the most important reason for choosing the usual source of care. Our results are expected to be of interest to decision- and policy-makers, as well as to individuals involved in risk assessment, because they advocate that it is not the demographic or even financial factors that play the primordial role in accessibility of health services, but the geographic ones.

This suggests that regional disparities are already leading to differences in access to health care and potentially to important differences in health status among the regions. It is not only the traditional urban-rural disparities that should be considered, but also the provincial and regional disparities that less frequently are accentuated in health care research in China.

We also found that between 1989 and 2004 the accessibility gap between hospitals and clinics in terms of geographic indicators has decreased, while the gap in financial accessibility has increased, making urban hospitals the least accessible facilities. Access to both hospitals and clinics in urban and rural areas is mostly conditioned by geographic factors, namely the travel method, region of residence and the availability of health care facilities. Patients who were able to reach the facilities on foot usually enjoyed better access than those who were not. Similarly, residents of the West along with the provinces with higher availability of health care facilities also tended to have better potential access than their eastern counterparts. This surprising conclusion might be related to the fact that Guangxi and Guizhou (the 2 western provinces analyzed in the survey) are not typical western provinces and thus might not be representative of the general health care access situation in the West.

This study however is subject to some limitations. Firstly, while establishing the access measurement index allowed us to quantify the accessibility, the index proposed here is based on only four variables. In order to better reflect the reality, the index should include more dimensions of access (quality, size, and ownership of the facilities, as well as use of services and satisfaction) and the variables in the index should be weighted, since some access barriers are more important than others. In fact, constructing a more representative measure would require far more information concerning the prices or quality of facilities than CHNS or other publicly available data source can offer. Thus, future research should address this issue when data become available. Secondly, although, CHNS is considered to be one of the best available Chinese datasets, the utility of the data for geographic analysis is somewhat limited due to confidentiality restrictions. The studied communities are held confidential and thus the smallest identifiable geographic unit that can be used is the province. Also some of the measurement units used in the longitudinal master files (e.g. travel time by bicycle) are not meaningful since not everyone uses this particular means of transportation. Hougaard, Osterdal and Yu (2008) go further, suggesting that any empirical analysis of the Chinese health care system will suffer from considerable data uncertainties and a crucial lack of relevant data. Thirdly, CHNS data used for the analysis are self-reported and not confirmed by a health-care provider (concerning average waiting times and service charges) or by GIS estimations (concerning the travel time); however, such self-reports have been validated previously. Despite these limitations, this study provides theoretical, methodological and empirical contributions, filling the gap in geographic literature on accessibility of health care in China.

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