Hospital Choice of Rural Poor in Developing Countries: Case Study in Sri Lanka

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Abstract. This paper analyzes patients' choice of health service facilities, using empirical data collected through a survey conducted in rural areas of Sri Lanka. The hospital choice model takes into account disease types and transportation modal choice, both of which are estimated through the collected data. The results show that (i) the unavailability of water and the general aging (>65 years) of the population increase the possibility that long-term critical diseases will occur, whereas an increase in the number of sanitary facilities decreases the possibility of long-term critical diseases; (ii) an increase in people aged >65 years, a decrease of income levels <4,500 Rupees, and an increase in the female population will increase the spread of long-term, non-critical diseases; (iii) children <10 years and members of households without access to proper sanitary facilities have a greater likelihood of suffering from short-term critical diseases; (iv) the increase in population of the 10–65 years age group increases the spread of short-term, non-critical diseases; (v) the number of beds and doctors contribute to the attractiveness of a hospital; (vi) patients with long-term diseases consider the number of beds more important than those with short-term diseases, in choosing a hospital; and (vii) the value of travel time in accessing health services is much higher than the average wage level.

Key Words: hospital choice, rural poor, developing country, Sri Lanka, accessibility

INTRODUCTION

The successes of Sri Lanka's health care system have been widely reported, given that country's relatively low per-capita income and health care expenditures (*1*). Public health care system services are free at any facility in the country. Although many developing countries privatized their health care systems in the 1980s and 1990s, Sri Lanka has had a public care system since achieving independence in 1948; this has, to some extent, contributed to equality in accessing health care services. As of 2006, the average life expectancy is 72 years and the infant mortality rate is 13 per 1,000 infants. However, inequality is still observed among different income groups and among different regions in Sri Lanka. Recently, the number of cases of non-communicable disease such as diabetes has rapidly increased, and this impacts patient equality in accessibility (*2*). Although patients require frequent visits to clinics that have appropriate diagnosis and disease-management facilities, these clinics are often far-removed from rural communities. This incurs upon patients long travel times and high travel costs (*3*). There has been a dearth of research into the accessibility of low-income, rural people in developing countries to health care services; this study surveys patient access to hospitals via household interviews in rural areas of Sri Lanka and analyzes their related behaviors.

This paper is organized as follows. Section 2 reviews past research into accessibility to health services in developing countries. Section 3 discusses the hospital system in Sri Lanka, and the household survey is presented in Section 4. Section 5 presents the hospital choice model, which incorporates disease types and transportation modal choices. Finally, Section 5 concludes the paper and discusses issues requiring further study.

REVIEW OF PAST RESEARCH INTO ACCESSIBILITY TO HEALTH CARE IN DEVELOPING COUNTRIES

Past Research into Accessibility Poverty

For many of the world's poor rural populations, mobility is a key to accessing and being accessed by biomedical health services and technologies; nonetheless, this issue has received scant research attention (*4*). Mobility in terms of access to health services has also not been central to development reports and evaluations, and mobility is only occasionally mentioned in relation to health. Generally speaking, accessibility poverty to health services can be categorized as absolute accessibility poverty or relative accessibility poverty. In terms of the former, USAID (*5*) states that a variety of factors block the urban poor's access to health services: Services may be far-removed from main transportation routes, for example, preventing residents from reaching nearby health and education facilities. Additionally, that report points out that barriers such as service costs, inconvenient hours, and a lack of transportation or requisite identification papers often exclude the poor from nearby services. There are also many studies showing that financial costs, distance from health outlets, and logistical difficulties such as finding an intermediate or motorized vehicle for patient transportation are linked to reduced uptake in biomedical services (*6*, *7*, *8*) and delayed health-seeking behaviors—both of which are factors implicated in reductions in favorable health outcomes and increased morbidity and mortality in Vietnam (*9*). Terra de Souza et al. (*10*) report that travel costs account for 25% of the total health care cost in Brazil.

On the other hand, relative accessibility poverty to health services is discussed mainly from the viewpoints of primary care. Primary care is defined as "the provision of integrated, accessible health services by clinicians who are accountable for addressing a large majority of personal health care needs, developing a sustained partnership with patients, and practicing in the context of family and community" (*11*). One of the reasons for inequality of accessibility to the health service in developing countries is that the locations of health facilities are not well planned; a number of studies point out that many people cannot access health services because of the inappropriate allocation of health facilities in low-income countries (*12*, *13*).

Past Case Studies into Access to Health Service in Developing Countries

Case studies into accessibility to health services have also been undertaken recently in developing countries. For example, it has been reported that the poor in Cambodia cannot enjoy health services, due to a lack of health service management on the part of their government (*14*, *15*). Tanser et al. (*16*) interviewed 23,000 households regarding clinic use in South Africa and analyzed travel costs within a geographical information system, to estimate mean travel times to clinics and derive clinic catchments. Their study shows a higher rate of usage of district private medical practitioners by urban residents than rural/para-urban residents; it also shows that the modal share of public transport increases as the distance to a clinic increases. Ajala et al. (*17*) also examine accessibility to health care facilities, especially in rural areas of Nigeria; that study indicates that the available health care facilities are grossly inadequate and their distribution is symptomatic of serious inequalities.

Some studies have surveyed access to health services in Sri Lanka. Russel (*18*) focuses on patient trust, because of its effect on treatment-seeking behavior and the treatment costs incurred by poor households in Sri

Lanka. That study also shows that people are willing to pay for private services because it saves time, doctors are perceived as being more attentive, and the patients feel that they can build better relationships with private doctors. Nonetheless, studies that provide behavioral analyses of rural poor and their access to health services are still limited. For example, few studies consider the impact of disease type with regard to hospital choice. The current study attempts to consider disease type, in addition to information regarding accessibility, hospital performance, and patients' personal attributes, as they are brought to bear on hospital choice.

HEALTH SYSTEM IN SRI LANKA

Background

Sri Lanka is an island with a total land area of 65,610 km^2; it is significant to note that that figure includes 1,156 km^2 of inland waters. Its climate is affected by proximity to the equator, monsoons, and its elevation above sea level. The southwestern region and mountainous areas receive sufficient rain, but the north, north-central, eastern, and southeastern areas remain dry for a considerable part of the year. The economy is predominantly agricultural and 70% of the population lives in rural areas. Sri Lanka holds a unique position in South Asia, as one of the first of the less-developed nations to provide universal health and free education; public-sector health services have been offered, free of charge, for more than five decades (i.e., since 1951). The health system in Sri Lanka is enriched by a mix of Western, Ayurvedic, Unani, and homeopathic medical approaches, as well as several others. The health system is a two-tiered one, comprising public and private sectors; the former comprises Western and Ayurvedic systems, while the latter comprises practitioners of all types of medicine.

Health Policy in Sri Lanka

The health policy of the Sri Lankan government is directed at consolidating earlier gains, as well as adopting new policies to raise the health status of its people. The broad aims of its health policy are to increase life expectancy by reducing preventable deaths due to both communicable and non-communicable diseases; improve quality of life by reducing preventable disease, health problems, and disabilities; and emphasize the positive aspects of health through health education. These objectives will be achieved by controlling preventable diseases and by rolling out health promotion activities. Health expenditures account for 4.1% of the government's total expenditure.

The public sector provides health services to nearly 60% of the population; the Department of Health Services and the provincial health sector encompass the entire range of preventive, curative, and rehabilitative health service provision. A full 95% of inpatient care is provided by the public sector. The private sector, meanwhile, mainly provides curative care, which is estimated to comprise nearly 50% of the population's outpatient care and is largely concentrated in urban and suburban areas. The network of curative care institutions ranges from sophisticated teaching hospitals with specialized consultative services to small, central dispensaries that provide only outpatient services. Finally, it should be also noted that medicine is also provided free of charge in Sri Lanka.

Distinctions between hospitals are basically made on the basis of size and the range of facilities involved. There are three levels of curative care institutions, as listed below. However, patients can seek care in any medical institution of their choice.

- Primary health service institutions: central dispensaries, maternity homes, rural hospitals, peripheral units, and district hospitals
- Secondary care institutions: base and provincial hospitals
- Tertiary care institutions: teaching and special hospitals

The number of employed medical officers is steadily rising, as all medical graduates are being absorbed into the public sector. However, there is a significant imbalance existing in the distribution of current staff: In the northern and eastern provinces this is especially evident, while Colombo, Kandy and Galle have higher concentrations.

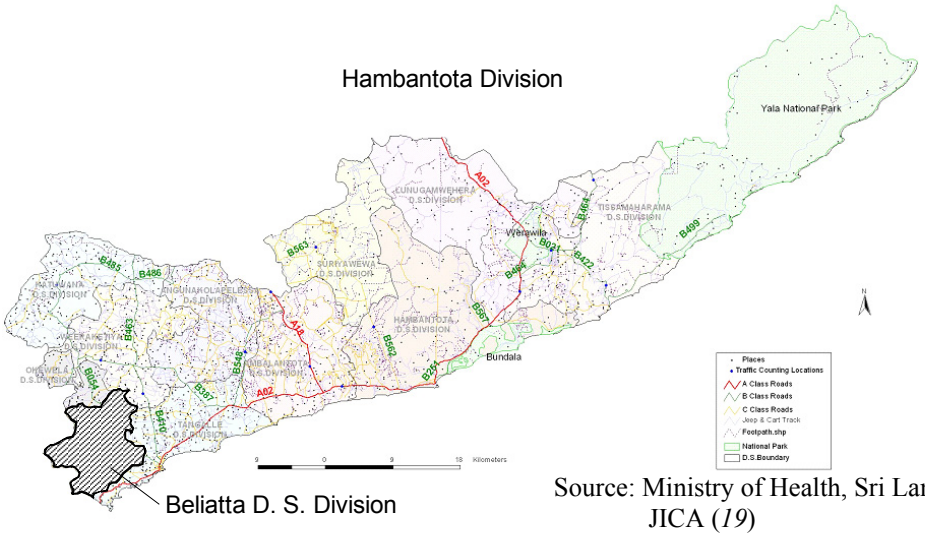
HOUSEHOLD SURVEY IN RURAL AREA OF SRI LANKA

Survey Area

We surveyed patients' experiences regarding access to hospitals in the rural areas of Sri Lanka. The survey used in this paper was designed and conducted by a study team from the University of Tokyo, which we were part.

The households in the Beliatta D.S. Division were randomly selected, based on the map of the district. The locations of the Hambantota District and Beliatta D.S. Division are shown in FIGURE 1. FIGURE 2 shows the details of the survey area. This area includes the seven grama niladari (G.N.) Divisions: Maligatenna, Pallatara, Nihiluwa, Dammula, Kambussawela, Godawela, and Waharalgoda. These areas were selected mainly because of their locations with respect to existing local hospitals. In addition, the public transportation bus stops in these areas are not easily accessed; on some routes therein, the frequency of operation is very low (i.e., only two trips per day or no availability at all). In such locales, people must rely upon three-wheelers—a very expensive mode of transport, compared to public transportation.

The main source of income for many local people in these areas is agriculture. Therefore, the prevalent attitude is to own as much land as possible, in order to earn higher incomes; most are also unwilling to readily sell or otherwise relinquish their places of origin. Consequently, people reside far apart from each other, which in turn leads to very low population densities that make the provision of certain infrastructure facilities—e.g., roads, water, and electricity—very difficult. Further, this terrain is very difficult, and so road maintenance is quite expensive. In any case, public transportation unavailability mainly results from certain routes being unprofitable for operators. Therefore, the main means of commuting is walking long distances, until public transit is reached. The net result is communities that are isolated in terms of transportation. This situation is quite different from those of other countries, where people tend to move into more convenient areas; such is often not an option for many Sri Lankans who are financially poor and cannot move to such areas. The current



Source: Ministry of Health, Sri Lanka and JICA (*19*)

FIGURE 1 Location of Beliatta D.S. Division.

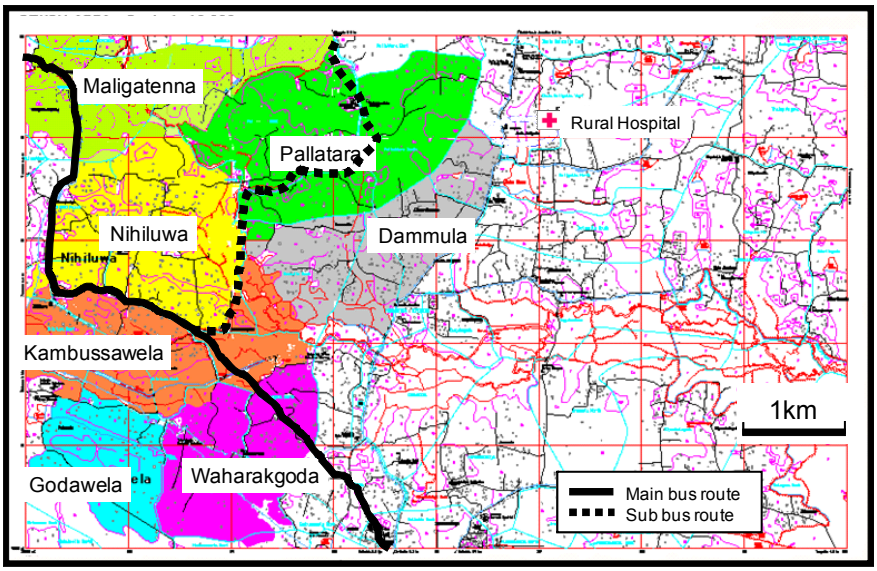


FIGURE 2 Map of Survey Area.

economic situation in Sri Lanka makes it even tougher, as the incomes in more affluent areas do not readily "trickle down" to rural communities.

Health Service in the Survey Area

Residents in this D.S. division—depending on their diseases, attitudes, and expectations—access the following hospitals: TH Karapitiya, GH Matara, BH Tangalle, DH Beliatta, RH Gangodagama, and the Ayurvedic hospital. The facilities are described as follows:

1. TH Karapitiya (1,465 beds, 400 doctors, 850 nursing staff): outpatient department (OPD), inpatient facilities, ambulance services, surgical theater, intensive care, X-ray, US scanning, CT scanning, laboratory services (biochemistry, pathology microbiology), and clinics (child, family planning, medical, surgical, pediatric, gynecology, ear, nose, and throat (ENT), eye, psychiatric, orthopedic, oncology, cardiology, etc.)
2. GH Matara (943 beds, 246 doctors, 500 nursing staff): OPD, inpatient facilities, ambulance services, surgical theater, intensive care, X-ray, US scanning, laboratory services (biochemistry, pathology, microbiology), clinics (child, family planning, medical, surgical, pediatric, gynecology, ENT, eye, psychiatric, orthopedic, oncology, and cardiology)
3. BH Tangalle (152 beds, 32 doctors): OPD, inpatient facilities, ambulance services, surgical theater, intensive care, X-ray, laboratory services (biochemistry only), clinics (child, family planning, medical, surgical, pediatric, eye)
4. DH Beliatta (90 beds, 10 doctors): OPD, inpatient facilities, ambulance services, clinics (child, family planning)
5. RH Gangodagama (60 beds, four doctors): OPD, inpatient facilities, ambulance services, clinics (child, family planning)
6. Ayurvedic hospital (90 beds, 10 traditional care doctors): This hospital offers traditional Ayurvedic care. OPD, inpatient facilities, clinics (child, gastritis, heart, etc.)

TH Karapitiya and GH Matara are quite comprehensive hospitals, compared to the other four; each consists of all the laboratory facilities and emergency facilities. Of these, TH Karapitiya is the superior facility, as this hospital is equipped with high-tech scanners and employs specialist doctors. Therefore, these two hospitals are more highly regarded by people, on account of their capacities, facilities, and specialized staff. As a result, these two hospitals are considered very attractive, as most diseases can be handled properly in these hospitals and through their available facilities. It could be said that Sri Lankan people have more faith in these two hospitals, even though they are highly congested; referrals made by doctors from other hospitals make them even more congested. Local hospitals such as rural hospitals and central dispensaries suffer from severe shortages of essential drugs, and that is one of the reasons why people are compelled to access higher-level hospitals.

Transportation in the Area

The distances from the survey area to the six nearest hospitals are: TH Karapitiya, 125 km; GH Matara, 36 km; BH Tangalle, 16 km; DH Beliatta, 5 km; RH Gangodagama, 3 km; and the Ayurvedic hospital, 6 km.
The transportation modal choices for people in this area would be either bus or three-wheeler. For reasons mentioned, buses are not always available; most of the time, especially in cases of emergency, patients rely upon expensive three-wheeler transport (i.e., ~50 Rupees/km). Accessing higher-levels hospitals that use three-wheelers forces patients to pay almost unaffordable amounts of money, even though medical services are provided free of charge. Such transport is also time-consuming, give road conditions and quality. Although health services are free, which is very helpful to poor people, the current conditions incur transportation costs that keep most of the rural poor from accessing these free services; they are ultimately left to suffer from a lack of adequate health service.

There is no direct bus service to DH Beliatta or the Ayurvedic hospital; the closest bus stop to either is about 1 km away. Therefore, all patients must either walk to the hospital or take a three-wheeler. As the roads in front of DH Beliatta and the Ayurvedic hospital are narrow (i.e., barely 3 m), it is difficult even for ambulances and private vehicles to access these two hospitals. In addition, because public transit operating hours are from 5 am to 9 pm, people are forced to depend on three-wheelers outside these hours, even though doing so is relatively expensive.

Survey Implementation

We designed an interview sheet for the survey, which asks interviewees to provide socio-demographic data and information regarding the number of household members and their experiences in visiting clinics or pharmacies in the past year (e.g., types of disease, hospitals visited, and transportation modes used). The survey was executed between March and May 2008, and 322 individuals in 75 households were interviewed.

Profiles of interviewed households, by G.N. Division, are summarized in TABLE 1. The average number of household members was 4.4; the number of female members per household was slightly higher than that of males. The average ages of household members were 36.5 years for males and 31.1 years for females, with age ranging from one to 88 years. The average monthly household income was 7,890 Rupees; 24% of households had a monthly income that put them below the poverty line. (The poverty line in Sri Lanka is 1,423 Rupees per capita, per month, as of 2002.) Note also that the poverty rate of households in the Hambantota District was 27.8% (*20*); on average, then, the surveyed households are quite representative of the typical households in this district. About one-half of the observed households had access to a protected well, whereas the remaining households used low-quality water. According to local medical doctors, many clients in this area have health problems, including diarrhea; this is mainly because of the poor quality of drinking water. There are poor sanitary facilities in many households; this too poses health problems in this area. Over one-third of the households have a mobile phone, although there is no fixed telephone network in this area. Only two households had automobiles (i.e., three-wheelers, which were used mainly for business). Although 11 households each owned a motorbike, most households had no private mode of transportation.

Among the households surveyed, a total of 822 visits to health service facilities were observed. For 731 of those visits, the types of disease involved are listed in TABLE 2. For 50.2% of the visits, flu, fever, cough, or

TABLE 1 Profile of observed households and their members

		Nihiluwa	Dammulla	Waharakgoda	Godawela
Number of households		12	11	10	11
Average household members	Male	2.3	2.0	2.0	2.0
	Female	2.1	2.4	2.3	2.4
Average age of household	Male	29.0	29.8	26.7	36.5
	Female	36.0	34.0	29.8	31.1
Monthly household income (Rupee)		7000	7591	9100	8000
Water supply	Tap water in	0	0	3	0
	Protected well in	6	6	2	3
	Others	6	5	5	8
Sanitary facilities	Water seal	0	0	3	0
	Pour flash	5	5	4	7
	Pit	7	6	3	4
Telephone availability	Available	2	3	7	5
	Unavailable	10	8	3	6
Available transportation mode	Automobile	0	0	1	0
	Motorcycle	2	1	3	1
	No	10	10	6	10

		Maligatenna	Kambussawela	Pallattara	Total
Number of households		10	9	12	75
Household members	Male	2.1	2.0	1.8	2.0
	Female	1.8	2.2	2.6	2.3
Age of household memebers	Male	32.6	32.1	35.7	31.8
	Female	39.8	31.6	40.8	34.9
Monthly household income (Rupee)		7225	8722	7875	7770
Water supply	Tap water in	0	1	1	5
	Protected well in	5	5	7	34
	Others	5	3	4	36
Sanitary facilities	Water seal	1	1	0	5
	Pour flash	3	7	8	39
	Pit	6	1	4	31
Telephone availability	Available	3	4	3	27
	Unavailable	7	5	9	48
Available transportation mode	Automobile	0	1	0	2
	Motorcycle	1	1	2	11
	No	9	7	10	62

cold was involved. Non-communicable diseases such as hypertension, diabetes, cancer, and asthma were also involved, accounting for 1.5%, 2.6%, 0.3%, and 6.0% of visits, respectively. There is no great variance in the disease profiles of the G.N. Divisions.

TABLE 3 shows the respondents' choices of health service facilities and their access to them. The health service facility chosen by the respondents was categorized as being one of seven: the Ayurvedic hospital, rural hospitals, district hospitals, provincial hospitals, base hospitals, teaching hospitals, and pharmacies. Table 3 shows that 10.5% of visits were to the nearest rural hospital, whereas 27.4% of visits were to a district hospital and 22.9% to a base hospital. It is noteworthy that 15.4% of visits were to pharmacies; this reflects the fact that

TABLE 2 Types of diseases of the respondents during a past year

Type of disease	Nihiluwa	Dammulla	Waharakgoda	Godawela
Athma	9	0	9	6
Heart	6	3	0	2
Cancer	2	0	0	0
Diabetes	0	4	2	5
Cholesterol	0	7	5	2
Kidney	0	5	2	10
Gastritis	0	0	0	4
Arthritis	0	0	0	0
Hypertension	0	0	0	0
Flu	17	14	20	20
Fever	23	22	19	16
Cold	15	16	15	22
Cough	9	5	7	5
Backpain	0	0	0	0
Tonsils	0	3	2	2
Typhoid	9	4	2	2
Diarrhea	12	13	12	6
Malaria	1	0	0	2
Burns	2	6		1
Injuries	1	1	2	4
Rheumatism	0	0	3	0
Eye	0	0	0	0
Teeth	4	0	0	0
Total	110	103	100	109

Type of disease	Maligatenna	Kambussawela	Pallatara	Total (%)
Athma	7	10	3	44 (6.0)
Heart	0	6	7	24 (3.3)
Cancer	0	0	0	2 (0.3)
Diabetes	0	6	2	19 (2.6)
Cholesterol	0	2	0	16 (2.2)
Kidney	3	0	9	29 (4.0)
Gastritis	0	0	6	10 (1.4)
Arthritis	5	0	3	8 (1.1)
Hypertension	8	3	0	11 (1.5)
Flu	17	20	15	123 (16.8)
Fever	20	10	12	122 (16.7)
Cold	12	20	22	122 (16.7)
Cough	7	7	6	46 (6.3)
Backpain	0	3	0	3 (0.4)
Tonsils	4	0	6	17 (2.3)
Typhoid	0	0	0	17 (2.3)
Diarrhea	7	7	8	65 (8.9)
Malaria	0	4	0	7 (1.0)
Burns	6	0	6	21 (2.9)
Injuries	0	1	1	10 (1.4)
Rheumatism	0	0	0	3 (0.4)
Eye	6	0	0	6 (0.8)
Teeth	2	0	0	6 (0.8)
Total	104	99	106	731

many people have better access to pharmacies than to hospitals. The average access travel time to health service facilities varies among the G.N. Divisions; this is mainly because of the differences in location among these G.N. Divisions. Among all divisions, the average travel time to a health service facility was 76.7 minutes; travel time in Maligatenna, however, was almost 2 h. This means that to access health services, local people are forced to travel for long periods of time; the average travel cost ranges from 62.6 to 158.7 Rupees. The average travel cost of all respondents was 113.5 Rupees; this is considerable, given that their average monthly income was some 7,770 Rupees.

TABLE 4 outlines the respondents' transportation modal choices. In all, 76.6% of visits were accessed by bus, while 21.9% were accessed by three-wheeler. Only 1.5% of respondents accessed health service facilities by walking.

TABLE 3 The choice results of health service and its access of respondents

		Nihiluwa	Dammulla	Waharakgoda	Godawela
Chosen health service	TH Karapitiya	5	6	0	10
	GH Matara	11	18	6	11
	BH Tangalle	37	37	27	21
	DH Beliatta	25	30	46	44
	RH Gangodagama	21	25	2	10
	Ayurvedic	8	14	3	4
	Pharmacy	14	24	19	15
Access travel time	Average	61.9	61.2	45	78.6
to health service (minutes)	Minimum	10	10	15	15
	Maximum	250	225	160	255
Access travel cost	Average	62.6	127.1	82.8	121.7
to health service (Rupee)	Minimum	6	10	6	10
	Maximum	560	2050	800	2300
		Maligatenna	Kambussawela	Pallattara	Total (%)
Chosen health service	TH Karapitiya	0	0	11	32 (3.8)
	GH Matara	27	15	17	105 (12.4)
	BH Tangalle	18	25	30	195 (22.9)
	DH Beliatta	31	32	25	233 (27.4)
	RH Gangodagama	8	3	20	89 (10.5)
	Ayurvedic	15	3	18	65 (7.6)
	Pharmacy	18	21	20	131 (15.4)
Access travel time	Average	117.1	74.2	96.2	76.7
to health service (minutes)	Minimum	30	25	20	10
	Maximum	245	180	320	320
Access travel cost	Average	158.7	107.1	125.1	113.5
to health service (Rupee)	Minimum	8	8	6	6
	Maximum	1500	810	2700	2700

TABLE 4 The choice results of transportation mode by the respondents

Health service	Bus	Threewheeler	Walk	Total
TH karapitiya	27	4	0	31
GH Matara	78	25	0	103
BH Tangalle	135	57	0	192
DH Beliatta	182	47	2	231
RH Gangodagama	42	27	10	79
Ayurvedic hospital	39	18	0	57
Pharmacy	123	1	0	124
Total (%)	626 (76.6)	179 (21.9)	12 (1.5)	817

MODEL

Model Formulation

To analyze the local people's choices of health service facilities, we analyze the joint choice—i.e., comprising hospital choice and transportation modal choice—using a simple discrete choice model. We assume that the hospital choice is dependent on the type of disease; this is because patients with serious illnesses or rare diseases are more likely to select well-equipped or special-device-equipped health service facilities, even if this choice incurs longer travel times than those incurred in traveling to the nearest rural hospital whose facilities or equipment are poorer. It is also assumed that the medical doctors or beds affect the attractiveness of a health service facility: The more numerous the medical doctors and beds, the more attractive the health service may be.

A nested logit model incorporating the health service facility choice and the transportation modal choice is formulated. Let the probability of choosing hospital j for individual i, who has disease type s, be

$$p_{ij|s} = \frac{\exp\left(\boldsymbol{\theta}\mathbf{x}_{ij} + \boldsymbol{\theta}_s \mathbf{x}_{i|s}\right)}{\sum_j \exp\left(\boldsymbol{\theta}\mathbf{x}_{ij} + \boldsymbol{\theta}_s \mathbf{x}_{i|s}\right)}, \tag{1}$$

where $\mathbf{x}_{ij}$ denotes the vector regarding the service factor of hospital j of individual i; $\mathbf{x}_{i|s}$ denotes the vector regarding the personal attributes of individual i who has disease type s; and $\boldsymbol{\theta}$ and $\boldsymbol{\theta}_s$ are the unknown coefficient vectors. We introduce the logsum value as one of $\mathbf{x}_j$, to reflect the influences from the access modal choice. The access modal choice is formulated with the following binary logit model:

$$p_{im|j} = \frac{\exp\left(\boldsymbol{\alpha}\mathbf{z}_{im|j}\right)}{\sum_m \exp\left(\boldsymbol{\alpha}\mathbf{z}_{im|j}\right)}, \tag{2}$$

where $\mathbf{z}_{im|j}$ refers to the vector regarding the service factor of travel mode m for individual i when choosing hospital j, and $\boldsymbol{\alpha}$ refers to the unknown coefficient vector. The following logsum value is used as one of $\mathbf{x}_{ij}$ in the utility function of the hospital choice model.

$$LS_{ij} = \ln \sum_m \exp\left(\boldsymbol{\alpha}\mathbf{z}_{im|j}\right) \tag{3}$$

In addition to the above model, we assume a membership function that formulates the probability of having disease type s, with the following multinomial logit model:

$$M_{is} = \frac{\exp\left(\boldsymbol{\beta}_s \mathbf{y}_i\right)}{\sum_{s'} \exp\left(\boldsymbol{\beta}_{s'} \mathbf{y}_i\right)}, \tag{4}$$

where M_{is} is the probability of having disease type s, for individual i; $\mathbf{y}_i$ is the vector regarding the personal attributes of individual i; and $\boldsymbol{\beta}_s$ is the unknown coefficients.

The unknown coefficients are estimated by maximizing the following likelihood function:

$$L = \prod_i \prod_j \prod_m M_{is}^{\delta_{is}} \cdot p_{ij|s}^{\delta_{ij|s}} \cdot p_{im|j}^{\delta_{im|j}}, \tag{5}$$

where δ_{is} is equal to 1 if individual i has disease type s, and 0 if not; $\delta_{ij|s}$ is equal to 1 if individual i chooses hospital j, and 0 if not; and $\delta_{im|j}$ is equal to 1 if individual i chooses travel mode m, and 0 if not.

Empirical Analysis

Seven hospitals were considered as hospital choices, while buses and three-wheelers are included in the access modal choices. Diseases are classified into four types, following the definitions of the World Health Organization: long-term critical diseases (D1); long-term, non-critical diseases (D2); short-term critical diseases (D3); and short-term, non-critical diseases (D4). D1 includes diseases of the blood and blood-forming organs, as well as certain disorders involving immune mechanisms; diseases of the nervous system; and heart disease, including cholesterol, hypertension, and nutritional diseases. D2 includes diseases of the respiratory system, and diseases of the circulatory system, such as asthma, arthritis, hepatitis and bronchitis. D3 includes certain infectious and parasitic diseases, injuries, poisonings, and certain other consequences of external causes; accidents and allergic reactions are also included in this category. D4 covers minor diseases of the eye and

adnexa, minor diseases of the ear and mastoid process, and diseases of the digestive process; diarrhea, colds, eye problems, teeth problems, and fevers are included in this category.

The results of the parameter estimations are summarized in TABLE 5. This shows that all the parameters are statistically significant and that the model fitness is good. First, the sign of coefficient *Water (D1)* is negative; this means that an individual who can access good-quality water has lower risk of D1 diseases. Second, the sign of coefficient *Age >65(D1)* is positive; this implies that an individual aged over 65 years has higher risk of D1 diseases. Third, the sign of coefficient *Sanitary (D1)* is negative; this implies that an individual with sanitary facilities has lower risk of D1 diseases. Fourth, the sign of coefficient *Age >65(D2)* is positive; this means that an individual aged over 65 has higher risk of D2 diseases. Fifth, the sign of coefficient *Income<4500* is negative; this implies that an individual earning less than 4500 Rupee per day has lower risk of D2 diseases. Sixth, the sign of *Gender (D2)* is negative; this implies that the female has lower risk of D2 diseases than male. Seventh, the sign of *Age<10 (D3)* is positive; this implies that a young child aged under 10 years has higher risk of D3 diseases than others. Eighth, the sign of *Sanitary (D3)* is negative; this implies an individual with sanitary facilities have lower risk of D3 diseases. Finally, the sign of *Age 10-65 (D4)* is positive; this implies that an individual aged between 10 and 65 has higher risk of D4 diseases.

With regards to hospitals that treat all types of diseases, the numbers of beds and doctors have a positive impact on utilities. On the one hand, the coefficient regarding the number of beds is the largest in D1, followed by D2, D3, and D4, in that order. This may reflect the fact that long-term diseases require longer bed-rest periods than short-term diseases, and that critical diseases require more frequent bed-rest periods than non-critical diseases. On the other hand, the coefficient regarding the number of doctors for D4 is lower than those of the other disease types. This means that patients with short-term, non-critical diseases are less likely to be swayed by the number of doctors when choosing a hospital, compared to patients with other disease types.

The parameter regarding inclusive value is positive and <1; this satisfies the condition pertaining to the correlation of error components in the utility functions of hospital choice and the transportation mode choice (*21*). The parameters of travel time and travel cost result in negative parameter values, indicating that an increase in either travel time or travel cost will decrease the utility of accessing hospital facilities. The estimated value of travel time is 1.795 Rupees per minute; this may be higher than the average wage rate, given that for our respondents, the average income per minute was about 0.8 Rupee. (In calculating this number, it is assumed

TABLE 5 Results of Model Estimation

Variables	Disease type	Coefficients	Standard errors	t-statistics
Membership function				
Water	D1	-0.0617	0.0151	-4.01
Age>65	D1	0.547	0.0975	3.46
Sanitary	D1	-0.0129	0.0021	-6.27
Age(>65)	D2	0.7207	0.1214	2.93
Income(<4500)	D2	-0.051	0.0165	-5.3
Gender	D2	-0.0108	0.0235	-3.2
Age(<10)	D3	0.485	0.0725	2.04
Sanitary	D3	-0.0143	0.0074	-5.61
Age(10-65)	D4	0.3652	0.165	4.78
Hospital choice model				
Number of beds	D1	0.0074	0.0023	3.18
Number of beds	D2	0.0058	0.0023	2.5
Number of beds	D3	0.0052	0.0023	2.44
Number of beds	D4	0.0048	0.0023	2.46
Number of doctors	D1	0.0259	0.0026	9.96
Number of doctors	D2	0.0262	0.0026	9.79
Number of doctors	D3	0.0258	0.0026	9.31
Number of doctors	D4	0.0232	0.0027	8.52
Inclusive value		0.241	0.0426	5.66
Access mode choice model				
Travel time		-0.0219	0.004	-5.44
Travel cost		-0.0122	0.0007	-17.8
Number of observations		822		
Initial log-likelihood		-4062		
Final log-likelihood		-3567.7		
Likelihood ratio		0.122		

that one worker earns 7,770 Rupees per month, and that there are 20 working days per month and eight working hours per day.) This is probably because the patients want to access the health service more immediately than the working travel; it may also reflect the fact that patients suffer from their diseases while en route to the hospital.

CONCLUSIONS

This paper analyzed patients' choices of health service facilities, using empirical data collected through a survey conducted in rural areas of Sri Lanka. First, we reviewed past research into accessibility to health services in developing countries; only a few studies have surveyed the poor's accessibility to health service facilities. We then provided an overview of the hospital system in Sri Lanka; one of the hallmarks of the Sri Lankan public health service system is that it is free, anywhere in the country. We then executed a household survey in the rural areas of Sri Lanka, during which we captured information from local people regarding their experiences in accessing health services. On the basis of the collected data, a hospital choice model was created, which incorporated the types of disease and the transportation modal choice involved. The model shows that (i) the unavailability of good-quality water and an increase in the population >65 increases the possibility of long-term critical diseases occurring, whereas an increase in the number of sanitary facilities decreases the possibility of long-term critical diseases; (ii) an increase in people aged >65, a decrease in income levels <4,500 Rupees, and an increase in the female population will increase the spread of long-term, non-critical diseases; (iii) children <10 and members of households lacking access to proper sanitary facilities have a higher tendency to suffer from short-term critical diseases; (iv) an increase in the population aged 10–65 increases the spread of short-term, non-critical diseases; (v) having a large numbers of beds and doctors contributes to the attractiveness of a hospital; (vi) when choosing a hospital, patients with long-term diseases consider the number of beds more important than do those with short-term diseases; (vii) when choosing a hospital, patients with critical diseases consider the number of beds more important than do those with non-critical diseases; (viii) when choosing a hospital, patients with short-term, non-critical diseases are less attracted by the number of doctors than are patients with other disease types; and (ix) the value of travel time in accessing the health service is much higher than the average wage level.

There are other issues that should be addressed. First, although the model in this paper uses a segmentation paradigm classified by disease type, a latent class model may be applicable to future studies. Second, disease type should be considered in the hospital choice model. Third, the hospital choice and/or the modal choice may vary among different income class or according to personal attributes; these factors should also be considered in modeling patient access behavior. Finally, accessibility should be measured with the estimated model, and the log-sum approach may be applicable, on the basis of our analysis. The accessibility measure may contribute to evaluating a project to improve the health care facilities in Sri Lanka from the viewpoint of transportation.

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