Inequality of Healthcare Service Accessibility among the Elderly in Kanchanaburi Province, Thailand: The Investigation of Geographical Factors

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Abstract

The public health care coverage, supported by the Department of Health of the Ministry of Public Health, has been adopted in Thailand since October 2001. These medical centers share a mission to serve Thai people equally. However, a significant number of elders do not have access for those health services. The elderly are a vulnerable group to the inequality of healthcare service accessibility because of the nature of their diseases, particularly the chronic ones, and low incomes. This study aims to answer whether the geographical factors affect the healthcare service accessibility among the elderly carrying chronic diseases in Kanchanaburi province in Thailand. Additionally, the study identifies the risk area of inaccessibility that may need supplemental healthcare services. Spatial analysis and the zero-inflated negative binomial regression model are deployed to predict the rate of physician visitation. Associated with geographical factors in statistical models, four main categories are taken into account for an analysis of the rate: demographic factors, socio-economic background, living arrangement, and transportation.

The study found that distance is negatively associated with the rate of physician visitation. As the distance between the household of the elderly and the healthcare center increases by one kilometer, there is 40% chance, measured by transportation route distance respectively, that the elderly will not go to visit the physicians. There is no statistical

difference of the rate of visit between the rural and the urban areas; however, among strata in rural areas the elderly living in rice field and plantation areas are more likely to visit physicians. Demographic factors have no effects, but socio-economic status, measured by working status, has a negative effect on the rate of visit. Even though living arrangement is not statistically significant, it lessens the negative impact of distance. The accessibility of motor vehicles for water transportation in households is negatively significant, while the accessibility of land transportation is not associated with the rate of visit. The accessibility of non-motor vehicles is positively associated with the rate of visit. Determined by a 30-minute drive with the speed limit of 20 kilometers per hour on local roads in Thailand, residences located 10 kilometers away from the nearest healthcare center would need supplemental healthcare delivery. Most of them are in the upland areas.

Introduction

The public health care coverage, supported by the Department of Health of the Ministry of Public Health (MOPH), has been adopted in Thailand since October 2001. This coverage requires many medical centers to provide a wide range of health services. These medical centers are located throughout Thailand, including sub-district health centers, district and provincial hospitals and non-MOPH and private hospitals (Tangcharoensathien V. and et al., 2002). Their shared mission is to serve Thai people equally. However, a significant number of elders in rural areas do not have access for those health services.

Many sociological research reveal factors associated with the health service utilization or the frequency of the physician visits in terms of sociological details. Those factors include demographic and socioeconomic, social-psychological, and social characteristics (Shapiro and

Roos, 1985, Wolch, 1980, Jeths and Thorslund, 1994). Additionally, among such influential factors, Davis (1991) has found that geographical location is a crucial factor in national health care. In addition, Feikin (2009) found a significant distance-decay effect in health care utilization in Kenya among the children with more severe illness. However, those factors were found in different contexts from the Thai society.

Since the elderly in rural areas are a vulnerable group to the inequalities of the healthcare-service accessibility due to the nature of their diseases, particularly the chronic ones and low income (Patrick et.al., 1988), this study focuses on healthcare-service accessibility among the elderly (Lima et.al., 2005). The preliminary finding has revealed that there was a significant difference of healthcare-service accessibility between the elderly in the urban (municipal areas) and the rural at 95-confidence level ($P<.05$). The number of observations who are elderly carrying at least a chronic disease is 2,072 and $R^2 = 0.0045$. The equation (1) shows that living in the municipality has significantly negative effects on the rate of physician visitation at the alpha level .05.

The rate of physician visitation = 1.61* -.29* municipality + ε (1)

This preliminary finding contradicts the conventional thought that the elderly who live in the municipality area should have the more rate of healthcare accessibility. However, this finding is insufficient to identify factors related to healthcare-service utilization in Kanchanaburi province, Thailand. Although the utilization of healthcare service depends upon supplies and demands, this study focuses on geographical factors that influence healthcare-service accessibility among the elderly in Kanchanaburi province in order to improve the accessibility to existing healthcare resources. In addition, the identification of geographical

health risk areas will also improve insufficient healthcare delivery. Hence, this leads to two research questions.

Research questions

1) Do geographical factors such as distance, transportation routes, and travelling method affect the elderly's healthcare-service accessibility? (Walsh et al., 1997)

2) If the geographical factors affect healthcare-service accessibility among the elderly, which areas need supplemental healthcare services?

Hypothesis

1) The further the healthcare centers are from the household locations, the less often the elderly visit physicians.

2) Living in non-urban areas, the less often the elderly visit physicians compared to an urban area.

Data

This study is based on the Kanchanaburi Demographic Surveillance System (KDSS) project, supported by Institute for Population and Social Research, Mahidol University, Thailand. Kanchanaburi province is located in western Thailand, about 200 kilometers far from Bangkok, the capital city of Thailand. Its west border is shared with Myanmar. KDSS conducted annual enumerations and it has completed five round surveys during 2000-2004. Obtained by random sampling, the subjects in five strata are composed of urban/semi-urban, rice field, plantation, upland, and mixed economy. Each stratum characterizes agriculturally as described by its name. These five strata contain 100 villages out of 959 villages (20 villages each stratum) distributed over the province. Approximately, 18,000 households in the

study areas are interviewed and their global positions are obtained. KDSS collects demographic data such as personal information, household information, health behavior, migration, mortality, and the spatial data of residence location. Figure 1 shows the location of Kanchanaburi province in Thailand and all household locations of the KDSS are classified by strata.

The objective of this study is to provide an analysis of the association between healthcare-service accessibility among the elderly in the studied areas and geographical characteristics of residences to answer the research questions clarified above. The study employs the dataset of Kanchanaburi Demographic Surveillance System in year 2004, of which the duration of surveillance is between July 1st, 2003 and June 30th, 2004. The number of 2,530 respondents is the elderly whose age 60 and above and were carrying at least a chronic disease. The dependent variable is the rate of physician visitation and independent variables include geographical, demographic, socio-economic factors, living arrangement, and vehicle possession in households.

Additionally, the "depression, disability and socio-economic position among elderly 'left behind' by out-migration: a multilevel study in Kanchanaburi province, Thailand," was conducted in 2006 based on the same individuals of the KDSS. It provides the relationship information between elders and their household members; however, the number of respondent is 1,047. Moreover, a spatial data of transportation routes, collected by Royal Thai Survey Department, Ministry of Defense in 1999, is used to measure the distance to access healthcare services.

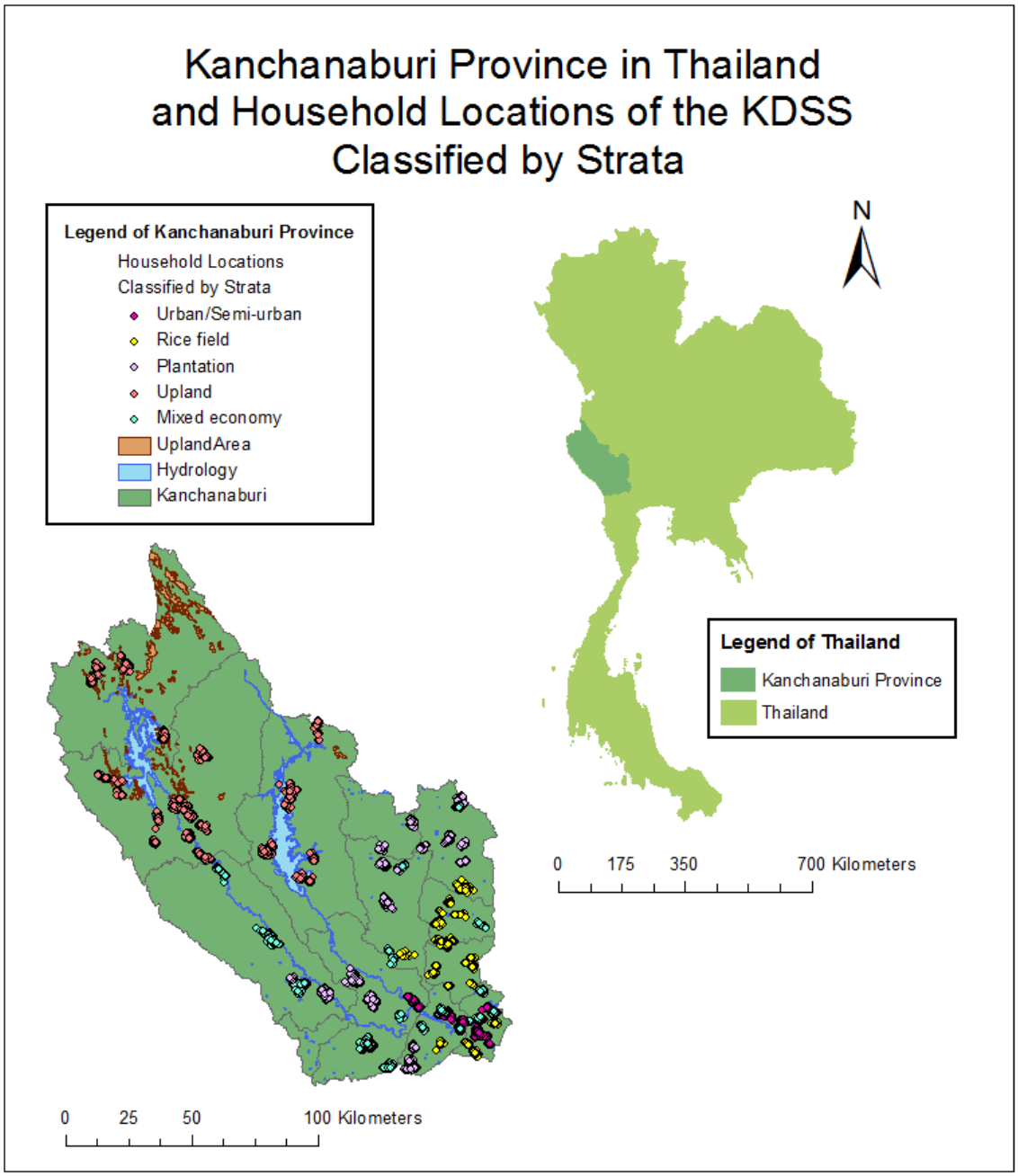

Figure 1 Kanchanaburi province in Thailand and household locations of the KDSS classified by strata

Assumption

The data did not identify the actual healthcare centers where the elderly visited a physician or treatments which the elderly received each time. Consequently, the number of physician visitation includes all treatments that may be related to chronic diseases, accidents, and other sicknesses. Since all elders in this study carried at least one chronic disease and these diseases require them to receive treatments regularly. Therefore, the elderly are assumed that they visit the nearest healthcare center for the purposes of general treatments that may be related to their chronic diseases.

Methodology

This study integrates two methods of spatial and statistical analysis. Since gathering information of the distance manually between all household locations and healthcare centers is not possible because of resource limitations, including time and budget, the geographical variable of distance is derived by spatial analysis. In order to prove if the distance is a crucial factor affecting the elderly's healthcare accessibility, a statistical method is employed in this study.

Spatial Analysis

The distance between the elderly's residences and the nearest healthcare center is determined by spatial analysis in ArcGIS. The distance through transportation routes is derived by a network analysis function of closest facility (Rosero-Bixby, 2004). This distance is the independent variables in the process of regression analysis.

Statistical Analysis

The zero-inflated negative binomial regression is the model for analysis. This regression model in this study is composed of two models analyzed in parallel, which are the predicting of membership not in the certain-zero groups and the predicting of membership in the certain-zero groups. Because some elders reported that they were sick or had some illnesses, but they did not make a visit, resulting the zero number of visit. The dependent variable, the number of physician visitation, is positive discrete number and contains a certain zeros as shown in the big spike of zero in figure 2. This causes the data over dispersed (mean=4.87 and standard deviation=5.50). As the result, the zero-inflated negative binomial regression is the best fit to the data.

Because the study emphasizes on the geographical factors' impact on the rate of visit, the geographical variables are used to test whether they somewhat cause the elderly in a certain zero group as shown in the logit model. However, the socio-economic status was tested in the logit model altogether with the geographical factors, they result non-significant effects in the certain zero group. Thus, the socio-economic factor was left out of the logit model, but it remains significantly in the negative binomial regression model.

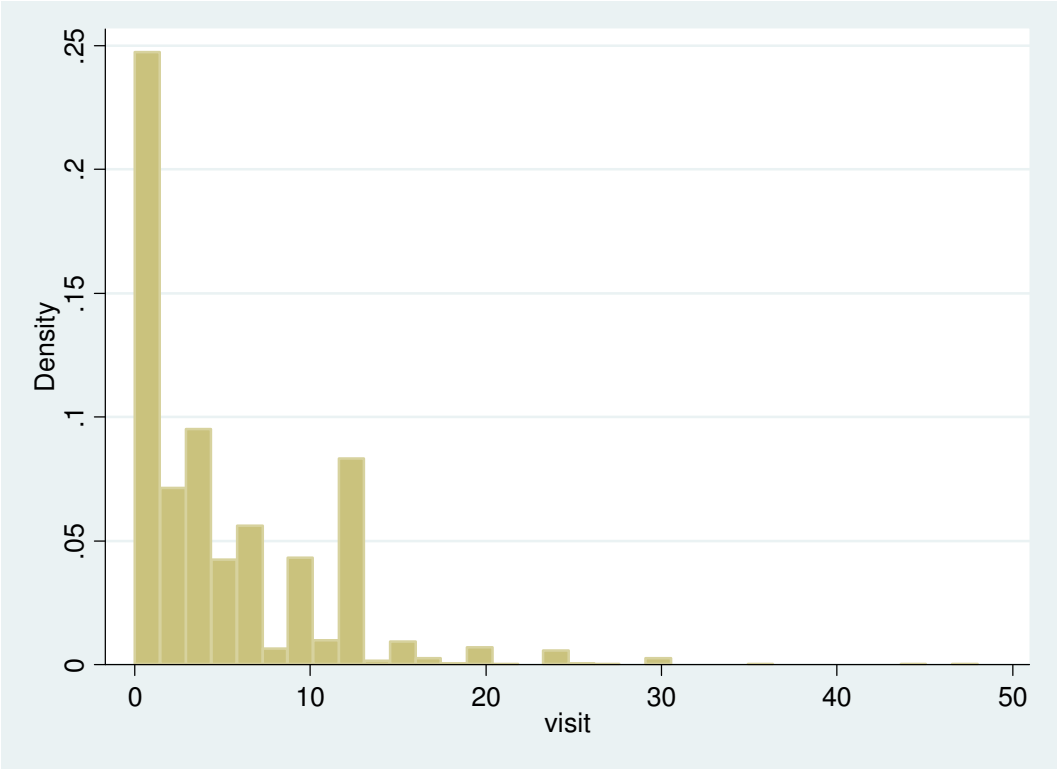

Figure 2 The data distribution of the number of physician visitation.

Analysis

In order to measure the impact of geographical factors on the healthcare service accessibility, six different models are developed. The first and second model is to test geographical factors only. The third model includes demographic and socio-economic factors as a controlling variable group. The fourth and fifth model test living arrangement and vehicle possession respectively by appending these two groups of variables into the thrid model. The last model includes all variables to see the magnitudes of each factor.

Independent variables of this study are classified into five categories: geographical, demographic, socioeconomic, living arrangement, and travelling methods. Since the study area is classified by characteristics of the area into five strata: urban/semi-urban, rice field,

plantation, upland, and mixed economy. The geographical variables are characteristics of stratum, denoted by their names, and the distance between the elderly's residences and the nearest healthcare center. Although those strata seem to be within the agricultural and economic classification, they are implicitly distinguished by its geographical characters of soil types, climates, and landscape. In addition to the impact of geographical factor affecting the healthcare utilization (Davis 1991), Feikin and colleagues (2009) found a significant distance-decay effect in health care utilization in Kenya among the children with more severe illness. Therefore, distances through transportation routes are tested in the models.

Demographic Data and Background of Healthcare

There are 2,530 elders whose age is 60 or above with at least one chronic disease. Fifty seven percent is between 60 and 69 years old, 34% is between 70 and 79 years old, and 9% is older than 80. Female is a majority of the elderly (62%). Table 1 shows the sex ratio of respondents classified by five-year age group. Ninety two percent is Thai, but the others are minorities such as the Karen, the Chinese, the Lao and etc. The majority (58%) of the elderly is married, 34 % is widow, 4% is single, 4% is separate, and less than one percent is divorce. Nine-tenth (92%) of the elderly has less or only primary education, while one-third (33%) has no education. Almost a half of the elderly (48%) is still working.

Table 1 Sex ratio of respondents classified by age group (N=2,530)

Age Group	Number of Elderly	Male(%)	Female(%)	Total (100%)
60-64	786	39.3	60.7	31.1
65-69	654	37.0	63.0	25.8
70-74	532	39.8	60.2	21.0
75-79	327	38.2	61.8	12.9
80-84	152	34.9	65.1	6.0
85+	79	43.0	57.0	3.1

Healthcare center

There were 143 local primary healthcare centers and 16 public hospitals in Kanchanaburi province in 2004 as shown in table 2. Typically, local primary healthcare centers did not have any doctors. Figure 3 shows the spatial distribution of the elderly carrying diseases and the location of healthcare centers in Kanchanaburi province. The map spatially portraits the healthcare demands of the elderly over study areas.

Table 2 Types and the number of healthcare centers in Kanchanaburi province

Type of Healthcare Center	Number
Provincial Hospital	3
District Hospital	13
Local Primary Healthcare Center	143
Total	159

Health Risk

Table 3 shows the first-ten ranks of diseases carried by the elderly living within the study areas. Many diseases, for examples, hypertension, myalgia, diabetes, and heart disease, are chronic diseases. The elders carrying diseases tend to need regularly visit physicians.

Table 3 First-ten ranks of diseases carried by elders

Rank	Diseases	Number of Elders Carrying Diseases
1	Hypertension	768
2	Myalgia/ Arthralgia	437
3	Diabetes Mellitus	353
4	Peptic ulcer / enteritis / hernia/ appendicitis	307
5	Heart disease i.e Rheumatic heart disease/ Congestive heart failure/ Cardiomegaly	244
6	Bone / articulation degenerate / fracture/ inflame/ infection/ gout/ rheumatoid arthritis	224
7	Backache	143
8	Eye disease (I.e. cataract/ glaucoma/ pterygium/ diplopia/ blind)	135
9	Hypotension	98
10	Headache/ migrain/ dizziness	84

Note: An elder may carry more than one disease

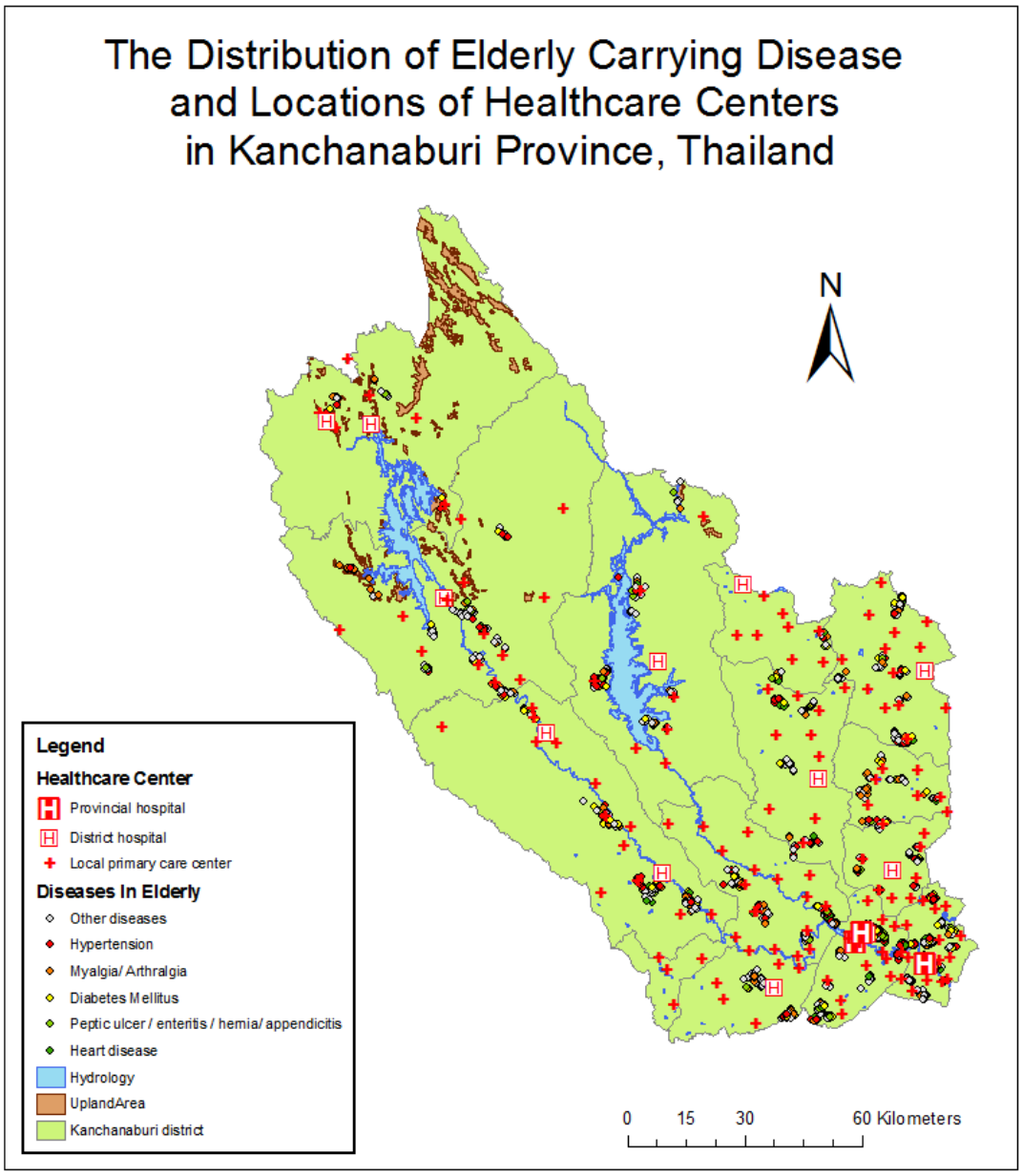

Figure 3 The Distribution of the Elderly Carrying Diseases and the Location of Healthcare Centers in Kanchanaburi Province, Thailand

Distance

The distance through transportation routes is measured from the elders' residences to the nearest healthcare center. This distance is mostly equal to the real distance that elders travel to the nearest healthcare center. Figure 4 demonstrates an area measured distance through transportation routes. Additionally, table 4 shows descriptive statistics of transportation route distance, classified by strata and figure 5 visually compares distance distribution and outliners among strata. The upland has the largest mean of distance and standard deviation and outliners can be found in urban/semi-urban, upland, and mixed economy areas.

Table 4 Descriptive statistics of transportation route distance

Strata	Observations	Mean (Km)	Standard Deviation (Km)	Min (Km)	Max (Km)
Urban/Semi-Urban	405	2.59	1.56	0.19	10.32
Rice Field	528	2.69	1.87	0.01	8.02
Plantation	328	4.74	2.45	0.05	10.81
Upland	328	5.24	4.60	0.09	18.17
Mixed Economy	477	3.87	2.01	0.06	9.60

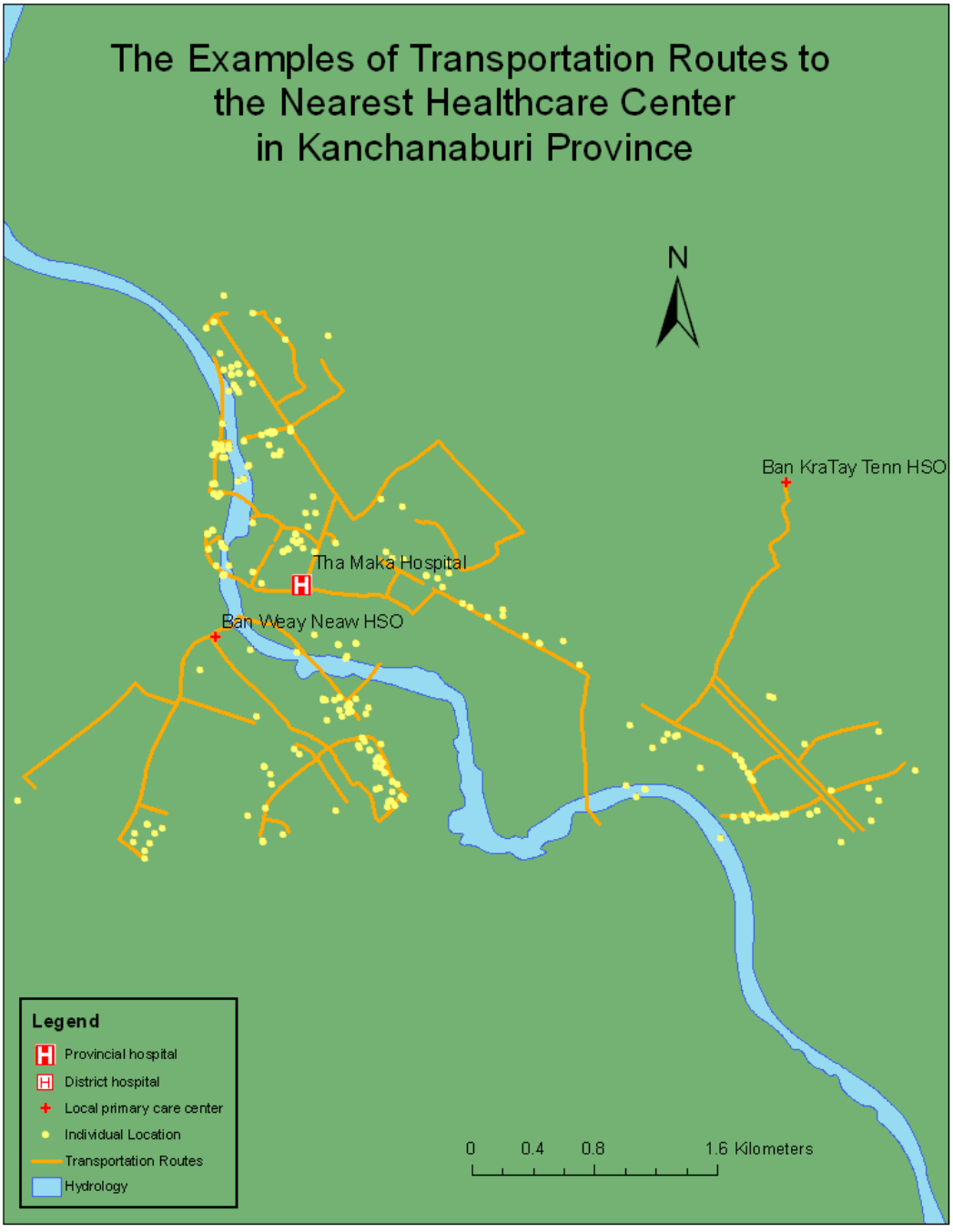

Figure 4 Distance between elders' residences and the nearest healthcare center through transportation routes in Kanchanaburi Province

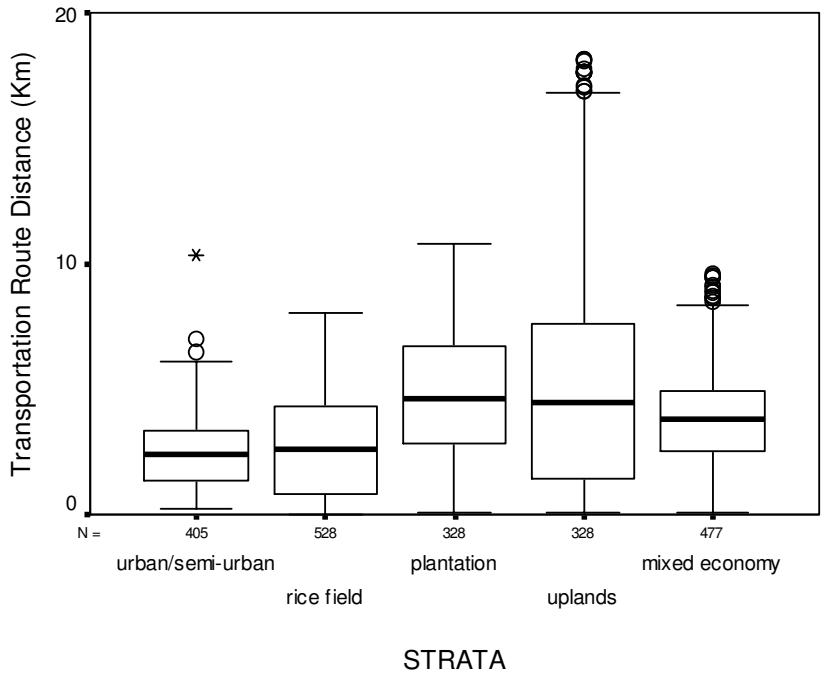

Figure 5 Comparison of distance distribution and outliners among strata

Demographic variables include individuals' age, sex, and marital status. Because the subject of this study is the elderly and this age passed the life course of marriage, it would be worth to measure if they are currently married to indicate their living status. Mostly, the socioeconomic variable is measured by individual or household income. However, almost of the Thai elders especially in non-urban area have been doing in agriculture or self-employed. In other words, typically, they are not in formal employment sectors. About half of the elderly in this study were working for economic reasons. Many of them depended on their family members in somehow such as providing help for food, travelling, and household products. Therefore, individual income would not be an accurate indicator. Due to the old age and no longer being the main provider for their households, the elderly may have less economic autonomy of household income. Hence, working status is considered as an indicator of economic status of the elderly. A study of living arrangement and health shows a positive

self-reported health outcome when the respondents whose age is 51-61 live with their spouse or children (Hughes and Waite, 2002). Therefore, the living arrangement with either spouse or child is taken into account for the analysis. Finally, the elderly's vehicle accessibility for travelling should be considered due to landscape characteristics. It is classified into three types of vehicles: motor vehicles on land, motor vehicles on water, and non-motor vehicles.

The zero-inflated negative binomial regression is employed as the best fit model for the data. The Vuong test compares the zero-inflated negative binomial model to a standard negative binomial model. As a result of significant z-value, the Vuong test shows that the zero-inflated negative binomial is better fit than the standard negative binomial for all models in this study. This model generates two separate models. The first model generates a logit model for the certain zero cases, predicting whether or not a respondent would be in this group. The second model is a negative binomial regression model, predicting the counts for those respondents who are not in certain zeros (Moghimbeigi, 2008). In the logit model of all studied models, the geographical factors are determined whether those factors affect the respondents to be in the certain zero. Additionally, these factors are included as in the based model of the negative binomial regression model and other variables are added up to see how coefficients of each variable type changes. Thus, there are two explanations for each studied models: predicting the number of visit for the elderly not in the certain zero group and predicting membership in the certain zero group.

Table 5 shows the correlations between the distance and background variables. Since the sample size after controlling living arrangement is much smaller, the correlations are shown as a comparison of those sample sizes. However, these correlations are not sufficient to

explain how distance affects the visits and magnitudes because of data over dispersed. Therefore, the zero-inflated negative binomial regression model is deployed.

Table 5 Correlation between the distance and background variables

Background Variables	Number of Visits	
	N=2,039	N=448
Distance	-0.035	0.053
Rice filed	0.033	0.046
Plantation	0.022	-0.018
Upland	0.036	0.101
Mixed economy	0.012	0.035
Age	0.007	0.045
Sex	0.004	0.035
Married	-0.013	-0.116
Work	-0.040	-0.145
Motor vehicle on land	-0.017	0.026
Motor vehicle on water	0.000	-0.153
Non-motor vehicle	0.023	-0.091
Child		-0.053
Spouse		0.044

Note: A smaller N remains after measured the distance through transportation routes by ArcGIS.

Table 6 The zero-inflated negative binomial regression of the elderly who carried chronic diseases with zero-inflated geographical factors

Independent variables	Model 1 (N=2,039)		Model 2 (N=2,039)		Model 3 (N=2,039)		Model 4 (N=448)		Model 5 (N=2,039)		Model 6 (N=448)	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Predicting the Elderly in the Certain Zero Group												
Distance through routes	-0.014	0.710	0.111	0.063	0.110	0.066	0.320*	0.023	0.106	0.071	0.308*	0.021
Rice filed			-1.350*	0.000	-1.351*	0.000	-1.895*	0.005	-1.352*	0.000	-1.814*	0.005
Plantation			-3.569*	0.021	-3.550*	0.023	-14.559	0.985	-3.504*	0.020	-15.418	0.989
Upland			-12.871	0.983	-6.215	0.741	-31.947	1.000	-5.927	0.679	-33.132	1.000
Mixed economy			-1.452*	0.000	-1.421*	0.000	-2.448*	0.000	-1.390*	0.000	-2.318*	0.000
Constant	-2.011	-2.435	-1.041*	0.000	-1.034*	0.000	-1.481*	0.007	-1.023*	0.000	-1.445*	0.006
Predicting for the Elderly Not in the Certain Zero Group												
Constant	1.759	0.000	1.755*	0.000	1.876*	0.000	2.514*	0.000	1.830*	0.000	2.703*	0.000
Distance through routes	-0.015	0.090	-0.020*	0.033	-0.020*	0.034	0.036	0.101	-0.020*	0.040	0.040	0.065
Rice filed			0.058	0.495	0.064	0.457	0.303	0.104	0.064	0.452	0.311	0.089
Plantation			-0.001	0.993	0.005	0.961	-0.009	0.965	0.017	0.860	-0.007	0.973
Upland			0.016	0.866	0.040	0.673	0.367	0.077	0.062	0.525	0.454*	0.028
Mixed economy			0.049	0.582	0.070	0.433	0.269	0.152	0.086	0.341	0.287	0.118
Age					-0.001	0.810	-0.012	0.177	-0.001	0.813	-0.014	0.113
Sex					-0.009	0.875	0.167	0.142	-0.010	0.863	0.174	0.122
Married					0.001	0.984	-0.117	0.529	0.001	0.987	-0.172	0.349
Work					-0.122*	0.031	-0.360*	0.002	-0.122*	0.029	-0.390*	0.001
Child							0.010	0.921			0.036	0.744
Spouse							-0.300	0.111			-0.239	0.198
Motor vehicle on land									-0.008	0.890	-0.246	0.055
Motor vehicle on water									-0.011	0.964	-1.286*	0.040
Non-motor vehicle									0.082	0.114	0.220*	0.035

Results

According to the statistical model, the results are described as two groups: the predicting for the elderly not in the certain zero group and the predicting for the elderly in the certain zero group. These two groups are analyzed parallely by negative binomail and logistic regression model respectively. The findings are litterally compared across models. The analysis to determine the distance through transportation routes and all other variables by the zero-inflated negative binomial regression is shown in table 6.

The distance through transportation routes reveals positive significance in the logit model, when controlling living arrangement. This means that the further distance between the elderly's location and the nearest healthcare center, the more likely the elderly are in the certain zero group. In other words, the further distance, the elderly do not make any visit at all. When the distance increases one kilometer, the chance of not going to visit a physician is about 30 percent higher.

Moreover, the odds from the logit models shows that the elderly living in the rice filed and mixed economy area in all models, either controlling or not controlling living arrangement, are less likely to be in a certain zero. The elderly living in the plantation area in model 2, 3, and 5, without controlling living arrangement, are less likely to be in a certain zero. While the elderly living in the plantation area in model 4 and 6, controlling living arrangement, are not significant at the alpha level .05. However, the upland area still does not show any significant association of being in a certain zero group. Thus, it could not be interpreted whether those elderly in the upland stratum are in the certain zero groups or not. However, the constant of the predicted odds contends that the elderly with the distance value of zero and

strata not in the non-urban areas are significant to be in the certain zero. Hence, compared to the urban/semi-urban, the elderly in the rice field and mixed economy either with or without controlling living arrangement and the elderly in the plantation without controlling living arrangement are more likely for going to visit a physician.

The distance through transportation routes in the negative binomial regression models reveals that there is a negatively significant association between the distance and the predicted value of visits in model 2, 3, and 5. However, when controlling living arrangement in model 4 and 6, they result in no significant effects of the distance. In addition, the upland area in model 6 remains the positive effect and significant association with the predicted value of visits. It could be concluded that the further the elderly from the nearest healthcare center, the less often the elderly visit a physician. Even though the distance afftects the predicted number of visits negatively, living arrangement would reduce the effects of distance as the result of the nonsignificant assocation to the predicted number of physician visitation. Moreover, the elderly living in the upland area are more likely to visit a physician more often than the elderly in the urban area do.

The demographic factors are not statically significant, but the socio-economic factor, measured by working status, has significantly negative effects on the rate of visits. Although living arrangement of child and spouse in households is not associated with the rate of physician visitation statistically, its impact is strong on the route distance. As a result in model 3 and 5, the direction of route distance's impact and magnitude are changed, compared to other models.

Vehicle possession in the elderly's households is not significant for the predicted number of visit in model 5 when not controlling living arrangement. However, motor vehicles for water transportation and non-motor vehicle in model 6 are significant. Having motor vehicles for water transportation has negative effects, but non-motor vehicle has positive effect on the predicted number of visit. Hence, the living arrangement remains strong effects on the vehicle possession.

Discussion

The findings would be discussed in four aspects: the impact of geographical factors, the socio-economic factor, how those factors interplay on healthcare accessibility, and the study identifies the area that is in the risk of healthcare inaccessibility and needs supplemental healthcare services.

How geographical factors affect the physician visitation

The distance has a significant impact on the rate of physician visitation among the elderly who carried chronic diseases in the studied areas in Kanchanaburi province. The transportation route distance contributes the negative effects for the rate. The further distance between the elderly's location and the nearest healthcare center, the less often the elderly made a visit. However, when controlling living arrangement of the elderly's child and spouse, the effect of distance turns to be not significant. This finding leads to the evidence that living arrangement is important to the rate of physician visitation. Although living arrangement does not show any significant effect, the elderly who lived with a child are more likely to visit a physician, but those who lived with spouse are less likely to do so. To explain this phenomenon, a child, as a working adult with physical and financial ability, would be able to

take their old parents or relatives to visit the physicians. While a spouse, mostly in the old age, is more likely to take care of his/her spouse at home due to the lack of physical and financial ability. An argument to explain why living arrangement variables having strong impact is not statistically significant is because of the smaller dataset collected in the different year. The dataset containing living arrangement provides only one-fifth subjects to match to the eligible elders in the study area.

According to the findings of the distance in the logit model, the further distance has a strong impact on making a decission to visit a physician. Since most of elderly are not be able to travel by themselves because of their physical conditions and inability to ride a motor vehicle, they would decide not to visit a physician unless they had a serious health problem. In the elderly's opinion, asking for a ride from their children or family members is considered as a disturbance because they as a young adult have to work. Therefore, the distance increases even only a kilometer, the chance to make a decission for not going is much high.

The rate of physician visitation that the elderly made in all strata in the non-urban areas is not different from the urban area; however, the upland area when controlling all variables is significant. A reason to explain why the elderly living in the upland area are more likely to visit a physician compared to the urban area is its geographically distinct characteristics. Not only does the upland have relatively high elevation, but this area has a rain forest which probably causes the eldelry having more severe and different diseases. Even though, this study focuses on the elderly having chronic diseases, the data does not allow for identifying specific treatments the elderly would need. Consequently, every treatment is counted into the number

of visits that might include any other treatments not related to chronic diseases. Health outcomes should be considered in the next research.

In addition, the elderly living in the rice field and mixed economy area are less likely not to make any visits at all. In the other hand, they are more likely to see a physician. Examined by the route distance, the elderly in the plantation area without controlling living arrangement are more likely to make visits as well. The geographical characteristics in terms of economic classification have impacts on some strata, especially the rice field and mixed economy relatively compared to the urban/semi-urban.

How socio-economic factor affects the physician visitation

Although many research often use income as an indicator of socio-economic status, the working status is used in this study. Because the elderly could not distinguish their individual income separately from their household income due to no longer being a household head at least economically. Consequently, the income could not be used to explain the rate of physician visitation well in this study. Thus, the working status is the plausible indicator of the eldelry's socio-economic status.

The working status plays an important role in all conditions as shown in all models. Because of an insufficient social welfare provided by the government and economic reasons to support the elderly themselves during their retired age, about half of the elderly are working and most of them are in agricultural segment. In respect of the finding, the elderly who were working are less like to visit a physician. This would be discussed into two aspects. First, the elderly depend much on their working for economic reasons. As a result, the elderly have to work and leaving their work for visiting a physician might cause some financial disadvantages.

Second, the elderly who are able to work may be an indicator of good health, so they do not need any medical treatment. These reasons consequently reveal as the rate of visit. However, to prove whether working status is endogenous is far beyond this study.

The vehicle possession in the elderly's household contends that only having motor vehicle for water transportation and non-motor vehicle are associated with the rate of visits. Having an accessibility of motor vehicles in their household does not encourage the elderly to make more visits, while non-motor vehicle possession results the positive number of visits. However, the possession of motor vehicles for water transportation indicates the geographical characteristic within or near water areas and the difficulty to travel. Additionally, the elderly may not be able to drive motor vehicles by themselves because of their physical barriers and ridding ability. Surprisingly, non-motor vehicles such as bicycles are associated with the higher number of visits. Explained by field work observations, non-motor vehicles would create social network by interactions among the elderly in villages and this social network allows them to help each another go to visit a physician by making a carpool. However, the qualitative data of the elderly's healthcare service seeking behavior is needed for the better explanation.

Interpretation of healthcare accessibility

The healthcare accessibility is usually influenced by many factors including demand and supply factors. This study considers only on the demand side and focuses on related factors. The study found both negatively and positively significant impact of factors. According to the two-parallelled statistical model, the findings would be discussed into two groups of elderly: the elderly in the certain zero and the elderly not in the certain zero group.

Among the elderly who are in the certain zero group, it has been found that distance and living in the rice field and mixed economy negatively influence to the rate of physician visitation. For better explain, the further distance made the elderly not to go to see a physician at all and the elderly living in the rice field and mixed economy area are more like to make a visit.

For another group of not in the certain zero, there are both of negative and positive impact. The distance, living in the upland area, working status, and vehicle possession of motor vehicles for water transportation and non-motor transportation are statistically associated with the rate of physician visitation. The further distance between household location and the nearest healthcare center, working, and the possession of motor vehicles in household have negative effects on the rate of visit. On the other hand, living in the upland area and having non-motor vehicles provide positive effects on the rate of visits.

The different geographical area would be a selective factor which leads to different economic status, resulting different abilities of travelling method and the support from the elderly's family members. Even though distance and geographical areas play important roles for going to see a physician among the elderly who carried chronic diseases in the study area, socio-economic status and living arrangement have a strong impact for visiting a physician as well. Transportation method seems to be necessary factors of healthcare accessibility; nontheless, the elderly could not make use of motor vehicles in their households. But rather, they need helps from family members, especially their children as well as their spouse, to access healthcare services. Due to the physical conditions of the old spouse, however, they could not get more access. Hence, having a child in their household is helpful for the

healthcare accessibility among people in the older age, while the elderly living with their spouse are less likely to visit a physician. Moreover, the households with two elders would demand more economic, medical, and travelling support than the household with one elder does. Therefore, taking care of the elderly with their spouse in the same household should be considered as a high priority.

Interestingly, it has been found that having a non-motor vehicle in households creates positive effects on the accessibility. Although the non-motor vehicle could not be used to travel to healthcare centers, it would help the elderly create social network among the elderly themselves to receive more health information and make a medical appointment on the same day. Thus, they can share cost of travelling to access healthcare services.

Area needs supplemental healthcare services

Given the distance-decay effect, the risk of healthcare inaccessibility among the elderly in Kanchanaburi province is determined by the distance between the elderly's residences and the nearest healthcare center through transportation routes. The certained time of 30-minute drive is considered as a threshold time to reach the nearest healthcare center (Ohta et.al., 2007). With the respect to Entwisle and colleagues's study, the transportation route distance with the speed limit of 20 kilometers per hour on local roads in Thailand (Entwisle and et. al., 1997), therefore, the distance of ten kilomenters consumes 30 minutes to travelling to the nearest healthcare center.

Therefore, with the condition of certained time and speed limit on local road, the ten-kilometer distance is longest distance that a patient should reach to the nearest healthcare center. As the result of 2.8% of the elderly who carried chronic diseases are at risk of

healthcare inaccessibility. The elderly's residence locations which are in the risk of healthcare service inaccessibility are shown in figure 6. Almost of them are in the upland area.

In addition, the primary healthcare centers are located in every sub-district, by which these healthcare centers are established by considering the administrative boundary of sub-districts and their population sizes. Thus, most of residences are closer to the primary healthcare centers instead of hospitals. However, the dataset does not provide the exact healthcare centers where the elderly received the services. Consequently, the elderly are assumed to go to the nearest one.

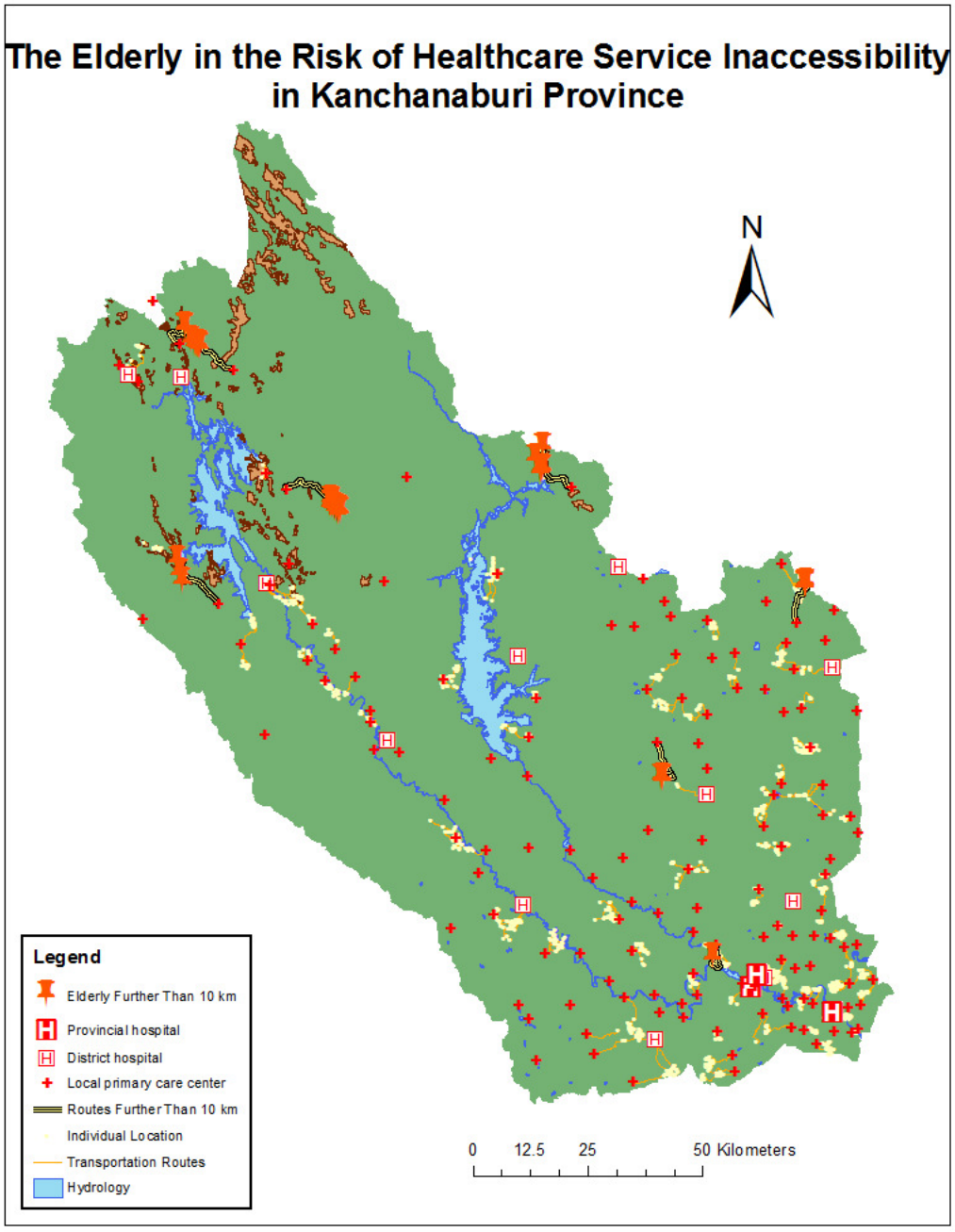

Figure 6 The elderly in the risk of healthcare service inaccessibility in Kanchanaburi province

Conclusion

This study aims to answer whether the geographical factors affect the healthcare service accessibility among the elderly carrying chronic diseases in Kanchanaburi province in Thailand. Additionally, the study tries to identify the risk area for their accessibility that may need supplemental healthcare services. Although the healthcare accessibility is associated with many factors of both demands and supplies, this study focuses on geographical factors, which are available in the Kanchanaburi Demographic Surveillance System. Five main categories are taken into account of the rate of physician visitation: geographical factors, demographic factors, socio-economic factors, living arrangement, and travelling methods.

The results reveal that geographical factors are associated with the rate of physician visitation; however, the effects of these factors are lessened by the subjects' living arrangement of their child and spouse. Living in the rice field and mixed economy consistently contributed the significant effects on the decision whether the elderly would go to visit a physician or not. The further distance between the elderly's residence location and the nearest healthcare center, the less likely the elderly visited a physician. This corresponds to the hypothesis; nevertheless, when controlling the living of child and spouse, the effect of distance changed into the different direction. In addition, working status, only one of demographic and socio-economic factors, played a negatively important role for the number of physician visitation in spite of being in the retired age (60 years old and over). Moreover, having accessibility to a motor vehicle in households is not helpful for the elderly to increase the rate of physician visitation. Especially, having a motor vehicle for water transportation causes a difficulty to access healthcare service due to living near or within wetland areas. The

elderly who have the accessibility of non-motor vehicle are more likely to have the higher rate of visits; however, this might need more qualitative data for a better explanation.

To identify the area that would need supplemental healthcare services in this study based on the finding of available geographical variables: distance and characteristics of areas, defined by strata. Thirty-minute drive through transportation routes is considered as the threshold of healthcare-accessed risk. Hence, the elderly would expect to reach the nearest healthcare center at the maximum distance of ten kilometers on local roads. As the results of spatial analysis, about three percent of the elderly have been found that they are in the risk area of healthcare services inaccessibility and most of them are in the upland areas.

Although a perfectly equal accessibility to healthcare services seems to be unrealistic due to its unequal distance, this study would consider a certain distance as an acceptable travelling point. Given controlling socioecnomic factors, those who can reach the services within the threshold time would be counted as an equal accessibility. Nonetheless, to promote healthcare programs successfully in Thailand, the efficient resource management should correspond with seeking behaviors among the elderly living in different geographical areas and receiving supports provided by their family members and neighbors (Hanlon et.al., 2006).

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