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Effect of Internal Migration on the Health of Taiwan's Elderly People

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Effect of Internal Migration on the Health of Taiwan's Elderly People

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Abstract

Prolonging life expectancy and low fertility rates accelerate population aging in Asian countries. Elderly people usually require more medical attention. The goal of this study is to explore the health of elderly migrants and to determine if there is health inequality behind internal migration. In this study we use data from NHI Research Database to define internal migrations and to measure the health of elderly migrants. We use the NHI records of outpatient visits to locate where people live (i.e., permanent residence) and to define internal migrations. Our goal is to evaluate whether the mortality rates and medical utilization between internal migrants and nonmigrants are the same. Additionally, if internal migration has an impact on the health of elderly people, then we want to know how long the effect will last (which can be treated as a selection effect). Our results of data analysis show that the elderly's migration activity via NHI records gradually decreased, as the official records from Ministry of the Interior indicate. As for the migrants' health, between-county (or long-distance) migrants have the highest mortality rates, whereas nonmigrants have the lowest morality rates. On the other hand, the medical expenditures of outpatient visits for between-county migrants were also higher, especially compared with those of nonmigrants. Likewise, elderly men had fewer outpatient visits but higher outpatient expenses, as the migrant approaches the time of death. We should continue exploring the effects of internal migration on the health of Taiwan's elderly people, such as the selection effect.

1. Introduction

Taiwan launched the National Health Insurance (NHI) in 1995, and people have been enjoying thorough medical accessibility ever since. As a result, the life expectancy in Taiwan has increased significantly, partly because of the fine medical service of the NHI, and the annual increment of life expectancy from 2000 to 2020 is about 0.20 and 0.24 years for males and females, respectively. Taiwanese residents are familiar with the NHI service, and about 99.9% of them are enrolled in the NHI program. In addition, the Taiwan government collects NHI-related records, namely, the National Health Insurance Research Databases (NHIRD), as a basis for improving the health of the Taiwanese people. Since the participation rate in the NHI is high, the NHIRD has been analyzed by many scholars and applied to many studies, such as in exploring domestic migration activities in Taiwan (Yue, Chien and Leong 2020; Yue, Leong and Lin 2022).

The area of Taiwan is approximately 36,000 square kilometers (or 14,000 square miles), not a big country, but the lifespan varies significantly between different counties. The male life expectancy of Taipei city (the capital city) was 77.78 in 2000, about 10 years more than that of Taitung county (eastern Taiwan). The difference of life expectancy between different counties has decreased in recent years, partly because of devoting more public resources to rural areas. For example, the life expectancy of Taipei city and Taitung county in 2020 is 81.43 and 72.46 (nine years difference), respectively. Still, the difference is too big to be ignored, and the gap between urban and rural areas is still obvious. Taipei city has the most abundant medical resources and employment opportunities, and it attracts people from nearby cities. For example, the daytime population in Taipei was 26% more than the nighttime population in 2021, according to phone records (Source: Ministry of the Interior, Taiwan).

The rights and duties of Taiwan's citizens are based on household registration records. For instance, people need to reside at a place for more than four months to have the right to participate as a voter. The household registration system usually provides reliable and accurate records of individual information (e.g., avoiding double counts), but it cannot reveal the people who actually live in a place (i.e., permanent residents) and their migration activities. Thus, Taiwan scholars often consider other data sources to estimate the internal migration activities and daytime populations in Taiwan. Personal telecommunication records (and internet usage) are one of the possible data sources, but the estimated values are likely to be biased. For example, Taiwan's elderly generally does not use the internet, and the estimated daytime/nighttime population in Taipei city by the Ministry of the Interior is likely to undercount older people.

In general, international migrants have lower mortality rates and longer life. Singh and Miller (2004) and Garcia et al. (2017) showed that immigrants enjoy longer life expectancies than local people in the U.S. Kibele et al. (2008) and Wallace and Kulu (2014) also found that international migrants have lower mortality rates than natives in Europe and England and Wales, respectively. On the other hand, it is still inconclusive if internal migrants have lower mortality rates. Johnson and Taylor (2012) and Black et al. (2015) showed that internal migrants in the U.S. have higher mortality rates. However, Kibele and Janssen (2013) and Wang, Yue and Wang (2019) found that the internal migrants have longer lives in the Netherlands and Taiwan, respectively.

In this study we use the NHIRD to explore internal migration activity in Taiwan, especially for people ages 65 and over, and to evaluate if migrants enjoy longer life expectancy. In particular, we compare the mortality rates and medical utilization of elderly migrants to those of elderly nonmigrants. We will use the NHIRD records of outpatient visits as a judging criterion for migration. Almost 90% people of all ages have at least one outpatient visit annually, and we can avoid the problem of underestimating population size caused by using inappropriate criteria (such as phone records). For the next section, we will introduce the

NHIRD and methodology used in this study, followed by an analysis of migration activities and comparison of mortality rates between elderly migrants and nonmigrants in Sections 3 and 4, respectively.

2. Data and Methodology

Taiwan has implemented quite a few social insurance programs since the 1990s to deal with the challenge of population aging, especially for the medical and economic needs of the elderly. NHI and pension reform probably are the two programs receiving the most attention. Taking the NHI as an example, Taiwan's residents are well satisfied with the health care service and accessibility, and 91.6% of them are satisfied with the service quality of the NHI, according to a survey of Taiwan's National Health Insurance Administration in 2021 (Lee et al., 2022). After more than 25 years of implementation, the NHI has become a part of daily life in Taiwan and people are quite familiar with the NHI-related health service.

The Taiwanese government has collected NHI data and constructed the NHIRD since launching national health insurance in 1995. Starting in 2000, the NHIRD has been open to scholars from academia, and the study results can serve as a reference for public health policy, as well as provide evidence to support clinical decisions in the medical profession (Hsieh et al. 2019). The NHIRD has received more attention recently because almost all Taiwan's residents participate in the NHI, which means that it is a population-level database (instead of sample data). For example, we can use the NHIRD to estimate the de jure population (or permanent residents) in Taiwan, and it can be treated as an alternative source of the census (Yue et al. 2020). A traditional census is usually conducted every 10 years and cannot provide timely population data. The low response rate of surveys also jeopardizes the traditional census, and many countries are seeking alternative methods for collecting national data (Yen and Yue 2010).

Using the population data as research material has become more difficult in Taiwan because the Personal Data Protection Act (PDPA) has been enforced since 2012. The goal of the PDPA is to "prevent harm on personality rights, and to facilitate the proper use of personal data."[1] If the data used, such as NHIRD, contain personal information, then they need to be de-identified, that is, breaking the relationship between data and specific persons that can directly or indirectly identify a natural person. All scholars are allowed to apply the data from NHIRD now, but there are legitimate privacy concerns, such as infringements of information privacy and privacy autonomy (Sung, Hsieh and Hu 2020). Many argue that authorizing the secondary use of government databases requires greater scrutiny (Yeh 2020).

Even though many controversies exist, more Taiwanese scholars from different professions apply Big Data techniques to analyze the NHIRD. Taking the estimate of Taiwan's de jure population as an example, the academic community has considered various criteria based on the records from the NHIRD. Wu (2004) found that the place of medical treatment for minor diseases is usually the primary medical institutions near the place of residence, and thus the place of treating minor diseases can be regarded as the place of permanent residence. Lin, Yang and Wen (2011) suggested using the upper respiratory tract infection as the criterion of minor diseases. The proposed method can generally obtain fine estimates of permanent residents except the elderly populations. Yue et al. (2020) proposed using the records of outpatient visits with medical cost below NT$555 (about US$20) to judge the permanent residence, and the estimated population is very close to that of using NHI service in Taiwan. We will apply Yue's criterion to determine the place of permanent residence in this study.

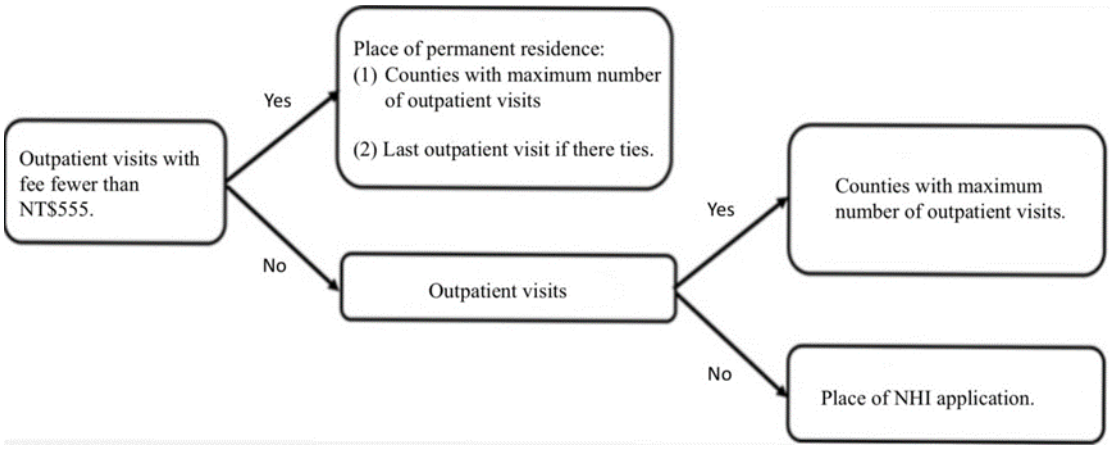
[1] https://law.moj.gov.tw/Eng/index.aspx

We use two databases from the NHIRD to explore the activities of domestic migration in Taiwan and compare the mortality rates of migrants and nonmigrants. Both data sets contain medical (e.g., in-patient and out-patient) records of one million individuals randomly sampled in 2005: one is for individuals at all ages (Longitudinal Health Insurance Database 2005, LHID2005), and the other is for people ages 65 and older (Longitudinal Health Insurance Database of the Elderly, LHIDE). No significant difference is seen with respect to gender between the people in the LHID2005/LHIDE and the original NHIRD to ensure the sample representativeness. The population size of Taiwan is around 23.5 million, and the sample of one million individuals is close to 5% of Taiwan's population.

Basically, many registration and claim files are found in these two databases, and three datasets mainly are used: registry for beneficiaries (ID), ambulatory care and out-patient records (CD) and in-patient records (DD). The ID file contains individuals' information, such as encrypted personal ID number, date of health application and date of surrender. The CD file covers individuals' outpatient-related records, including expenses, disease diagnosis and main operation records. The DD file keeps patients' inpatients records, including hospital expenses, primary and secondary diagnoses codes, medical institution code and hospitalization days. The data for these records are from 2002 to 2013, and their size is over 100 GB for each database, which has reached the level of Big Data. We use SQL (Structured Query Language) software for data processing and R language for statistical analysis.

We adapt the criteria of Yue et al. (2000) to judge the place of permanent residence in the rest of this study (Figure 2.1). More than 23,000 medical institutions are found in Taiwan, and it is very easy to access medical service, especially for minor diseases. Thus, Taiwanese won't consider long-distance travel for treating colds, and they tend to choose nearby clinics for less serious illness. In other words, the location of clinics for treating minor diseases can be used as the place of permanent residence. Also, more than 90% of Taiwan's residents have at least one outpatient visit, and we can use the place of NHI application if people have no outpatient visits. Generally, we treat the place with the maximal number of outpatient visits as the place of permanent residence.

Figure 2.1
CRITERIA OF PLACE OF PERMANENT RESIDENCE



We will use the SMR (Standardized Mortality Ratio) to compare the mortality rates of migrants and nonmigrants, in addition to measuring the mortality improvement over time. Crude mortality rates, defined as the number of deaths divided by the number of people, can be influenced by the age structure of populations, and more elderly people usually lead to higher crude mortality rates. The SMR is an indirect method of mortality standardization, and the SMR value indicates whether the target population has higher or lower (with SMR > 1 or SMR < 1) overall mortality rates than a reference population (Lai, Hardy

and Tsai 1996). The SMR is defined as the ratio of number of observed deaths to number of expected deaths, if the age-specific mortality rates of target population are identical to those of the reference population, expressed as

$$\text{SMR} = \frac{D^T}{\sum_x P_x^T \times q_x^R} \tag{2-1}$$

where D^T is the number of deaths in the target population, P_x^T is the number of people at age *x* in the target population, and q_x^R is the mortality rates at age *x* in the reference population.

The SMR is often used to compare mortality rates of different populations when the age-specific mortality rates of populations are not all known. We can extend the SMR to measure the mortality trend of a population. For example, suppose we want to study if the mortality improvement has continued in Taiwan between 2000 and 2020. We first compute the average age-specific mortality rates at all ages, defined as the ratio of aggregate number of deaths to aggregate number of people over 2000–2020, and treat this aggregate population as the reference population. Next, we can compute the SMR for 2000–2020. If the mortality rates decease for all ages, then the SMRs of populations between 2000 and 2020 should decrease as well. This kind of calculation is straightforward and can be applied to explore the mortality trend of certain populations, without considering mortality models. In other words, it can serve as a tool of exploratory data analysis.

We can make a similar modification to the SMR with respect to space and explore the spatial characteristics of mortality rates in a country by treating the whole nation as the reference population. We use the six major cities (population size more than two million) in Taiwan as a demonstration. Figure 2.2 shows the annual SMRs of six major cities in 1998–2018, and it seems that the mortality rates of these cities are very consistent in recent years. As expected, Taipei city has the lowest mortality rates, partly because of better resources. The cities in northern Taiwan generally have lower mortality rates, while the southern cities have higher mortality rates, even higher than the national averages (i.e., SMR > 1). Note that the radii of circles are in proportion to the population sizes of cities in Figure 2.2, and the locations of these cities (orange color) are shown in Figure 2.3.

Figure 2.2
SMR OF TAIWAN'S SIX MAJOR CITIES (1998–2018)

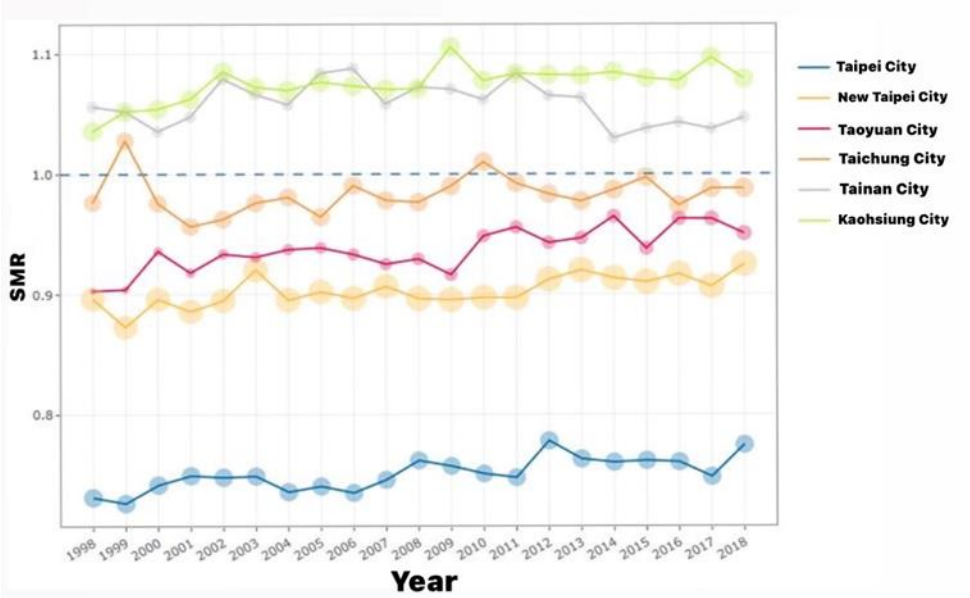
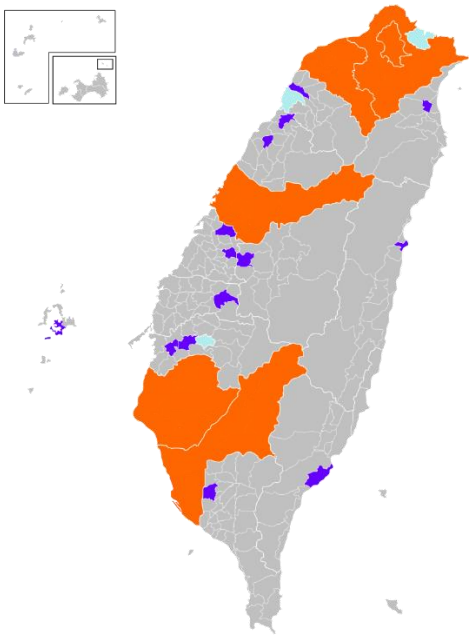


Figure 2.3
TAIWAN COUNTY-LEVEL MAP



Source: Wikipedia.

3. Domestic Migration Activities

We will focus on the county-level migration activities for the Taiwan main island, excluding three remote island counties that have a population close to 0.26 million (about 1% of the Taiwan population). More than 23,000 medical institutions (e.g., clinics and hospitals) had contracts with the NHI at the end of 2021,

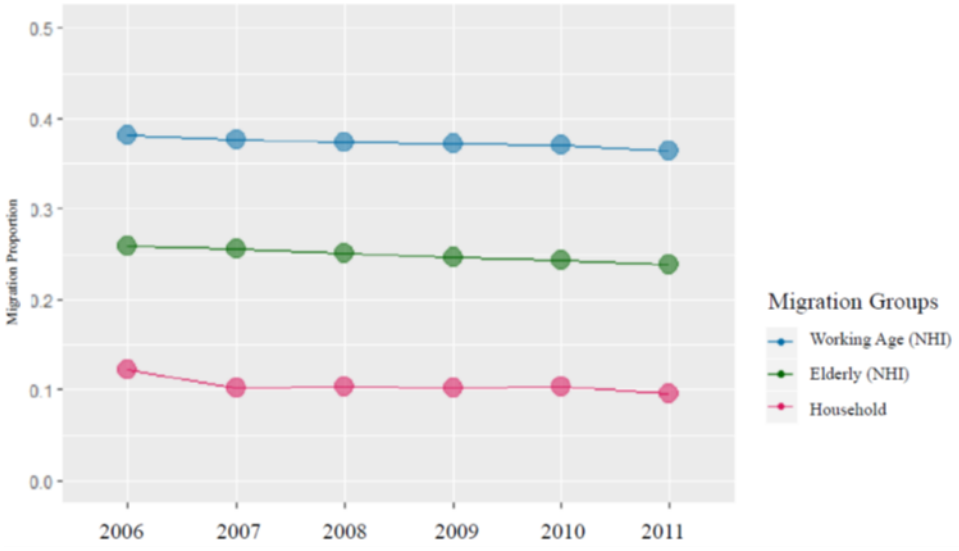
which means that at least 160 medical institutions are found in every county for the 19 Taiwan counties considered. In other words, we have enough location points to explore the domestic migration activities, and we will group them into two classes, within-county and between-county.

Table 3.1 shows the proportions of working age and elderly populations having internal migration in 2006–2011. It seems that, no matter the working age or elderly populations, the internal migration activities gradually slowed over the study period, for total, between-county and within-county migrations. Within-county migration activities are more active, and they account for five-eighths of total migration activities in working age populations and close to two-thirds in elderly populations. As expected, the elderly usually are less active in traveling, and thus the proportion of between-county migration for the elderly is smaller.

Table 3.1
MIGRATION PROPORTIONS OF WORKING AGE AND ELDERLY POPULATIONS (2006–2011)

	Working Age			Elderly		
	Total	Between Counties	Within County	Total	Between Counties	Within County
2006	38.17%	14.34%	23.83%	25.93%	8.25%	17.68%
2007	37.64	14.05	23.58	25.51	8.23	17.28
2008	37.33	13.92	23.41	25.11	8.08	17.03
2009	37.11	13.94	23.17	24.55	7.92	16.63
2010	36.99	13.83	23.16	24.29	7.76	16.53
2011	36.36	13.58	22.78	23.88	7.68	16.20

Figure 3.1
MIGRATION PROPORTIONS FROM NHI AND HOUSEHOLD REGISTRATION

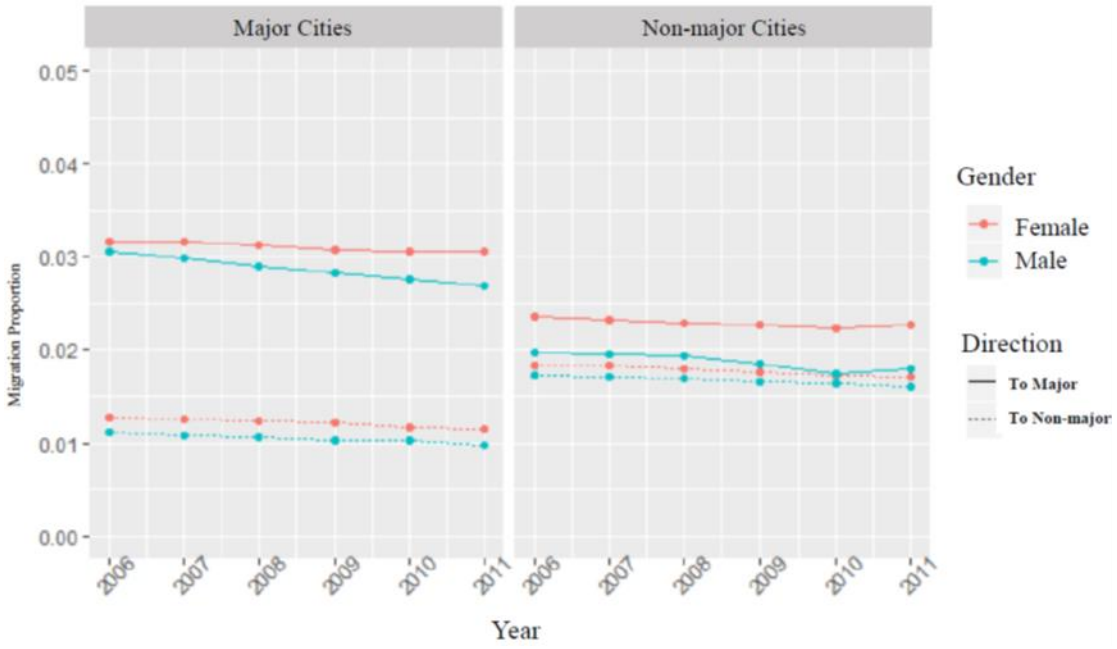


Next, we compare the internal migration activities calculated via the data from NHI and Household Registration (Figure 3.1). The official migration results from Household Registration contain both within-county and between-county migration, and we will consider only the total migration proportions from the Household Registration. Similar to those via the NHI, the internal migration activities via Household Registration decreased slowly, and this trend has continued after 2012 (from official statistics). Also, the internal migration activities from the NHI are more active, for both working ages and elderly. This indicates

that the results of internal migration in this study might not apply to other migration studies if the definition of internal migration is different. Still, the NHI definition can provide more migration results via various aspects that are not considered by the official statistics. We will discuss the mortality rates and medical utilization of the internal migrants in the next section.

As mentioned previously, the population proportion of six major cities is about 70%, and it is expected to increase in the future, because these people have more job opportunities and elderly-related social welfare. For example, Taiwan's semiconductor manufacturing is world renowned, and the world's most valuable semiconductor company, TSMC (Taiwan Semiconductor Manufacturing Company, Limited), will set up new wafer factories in Taiwan's major cities. In addition, major cities have more government budgets, and thus they offer more elderly benefits (e.g., local government cash gifts to the elderly). These can be treated as the pull factors in migration theory. We should use the between-county migration activities to evaluate whether major cities are attracting people to move in.

Figure 3.2
BETWEEN-COUNTY MIGRATION PROPORTIONS (WORKING AGE)

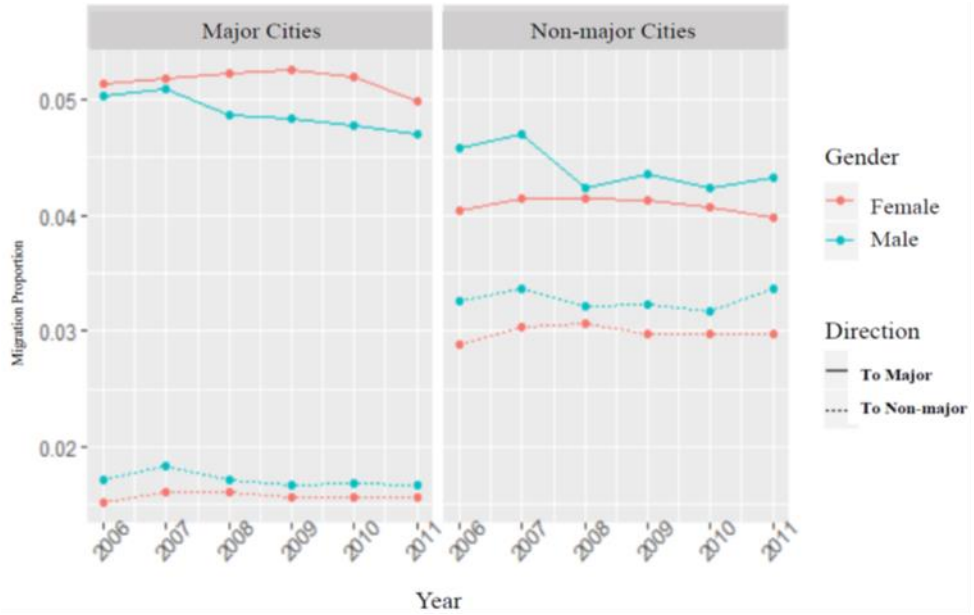


We can check the migration flows between major cities and nonmajor cities to confirm whether the major cities are more attractive to the public. We first explore the flows of working age populations (Figure 3.2). More migration flows are seen into six major cities, although the migration patterns of major and nonmajor cities are very different. For people moving out of major cities, about 80% of them chose to move to other major cities. The results for people moving out of nonmajor cities are similar, with about 60% of them moving into major cities (fewer than the case of moving out of major cities). We can also find gender differences in internal migration. In general, working age women are more willing to move, no matter into or out of cities.

For the elderly population, major cities are still more attractive, but the advantage is less obvious. For people moving out of major cities, about 70% would move to another major city and about 55% would move into major cities for people moving out of nonmajor cities. The gender difference of internal

migration is more significant for the elderly population, and women are also more willing to move for all cases. In general, Taiwan's elderly women are more willing to seek treatments from doctors and thus have higher internal migration activities (since our migration is judged based on medical utilization). If we regard internal migration as social participation, then our result is somewhat different from that of Huang and Yang (2013), where Taiwan's men had a higher level of social participation before retirement, but it decreased with time whereas that of elderly females increased with time.

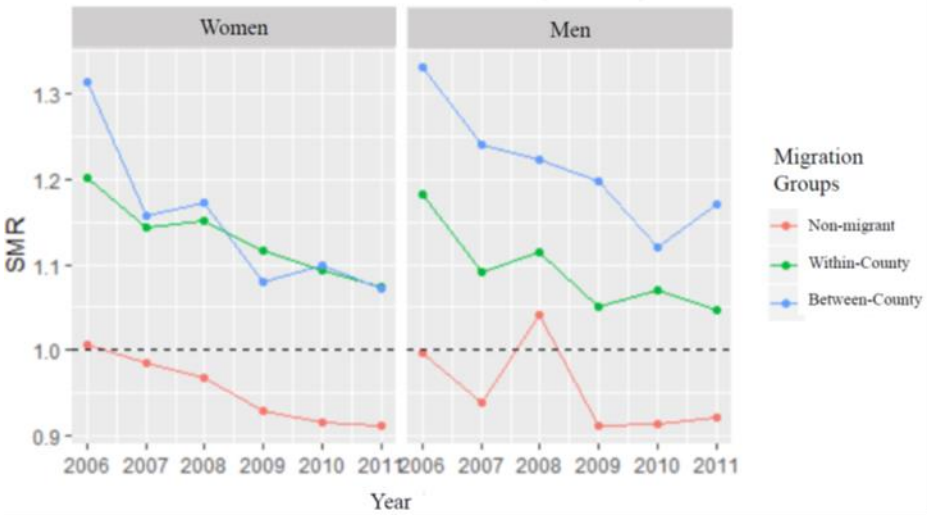
Figure 3.3
PROPORTIONS OF MIGRATION BETWEEN COUNTIES (ELDERLY)



4. Health of Domestic Migrants

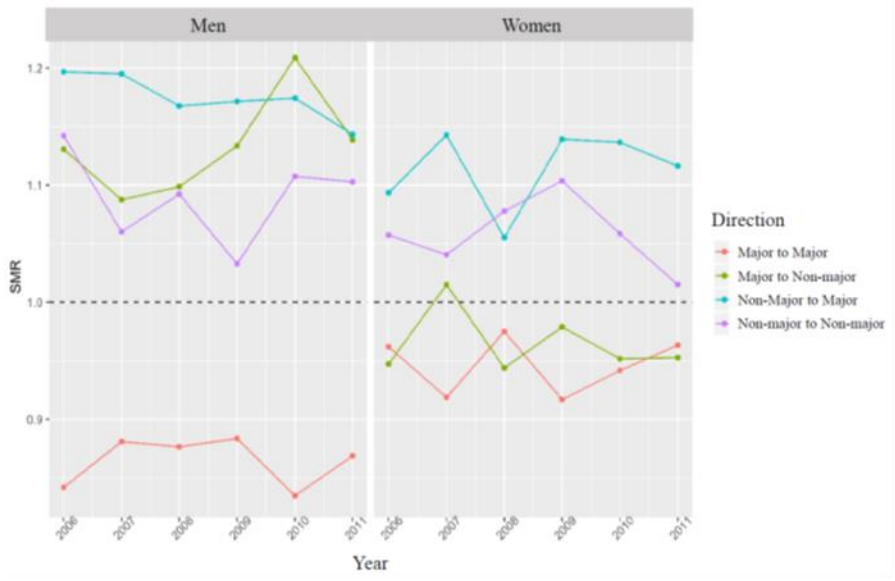
In this section we compare the mortality rates and medical utilization of elderly migrants and nonmigrants. However, no death records are kept in the NHI, and thus we adapt the death criteria from Yue, Wang and Hsu (2019). We should first examine the elderly mortality rates and use the SMRs between 2006 and 2011. Note that the SMRs can be used to describe the differences between migration groups and the mortality trend, as mentioned in section 2. The SMRs of all three groups (nonmigrants, within-county migrants and between-county migrants) in both sexes decrease with time, suggesting mortality improvement in 2006–2011. The elderly without internal migration generally have the lowest SMR, for both men and women. Between-county migrants have higher mortality rates, especially for the elderly men. We think that elderly men don't like to move (Figure 3.3), causing possible delay in seeking medical attention, and their health conditions are not well when they make between-county migration.

Figure 4.1
SMR OF VARIOUS MIGRATION GROUPS (ELDERLY)



We expect that the SMRs of major and nonmajor cities migration are different, since major cities have better overall resources, and they also show gender differences (Figure 4.2). The reference population in Figure 4.2 is the aggregation populations over 2006–2011, and unlike the results in Figure 4.1, no mortality improvement is seen over time for different groups of internal migration. Elderly women moving from major cities have significantly lower mortality rates. The results are not the same for the case of elderly men, and only the group moving from major cities to major cities have lower mortality rates. Interestingly, elderly men moving from major cities to nonmajor cities have higher SMRs than those moving from nonmajor cities to nonmajor cities.

Figure 4.2
SMR OF MAJOR AND NONMAJOR CITIES MIGRATION (ELDERLY)



We explored the medical utilization of internal migration and use the case of elderly men as a demonstration (Figure 4.3). We apply the idea of SMR to other medical utilization, such as medical expense and number of outpatient visits, without changing the original name. We also define the reference

population as the aggregation of the whole population in 2006–2011, letting let us observe the medical utilization for each migration group and their time trends. The medical expenses, numbers of outpatient visits and expenses per outpatient visit all increased in 2006–2011, and their increments look very similar for three migration groups. The results of different types of medical utilization are interesting. The group of between-county migration has the highest total medical expenses but the lowest number of outpatient visits. In other words, the medical expenses per outpatient visit for the between-county migration are the highest, and this suggests that they may have the worst health. We will need to collect more information to investigate why the between-county migrants have the highest mortality rates.

Figure 4.3

MEDICAL UTILIZATION OF INTERNAL MIGRATION (ELDERLY)

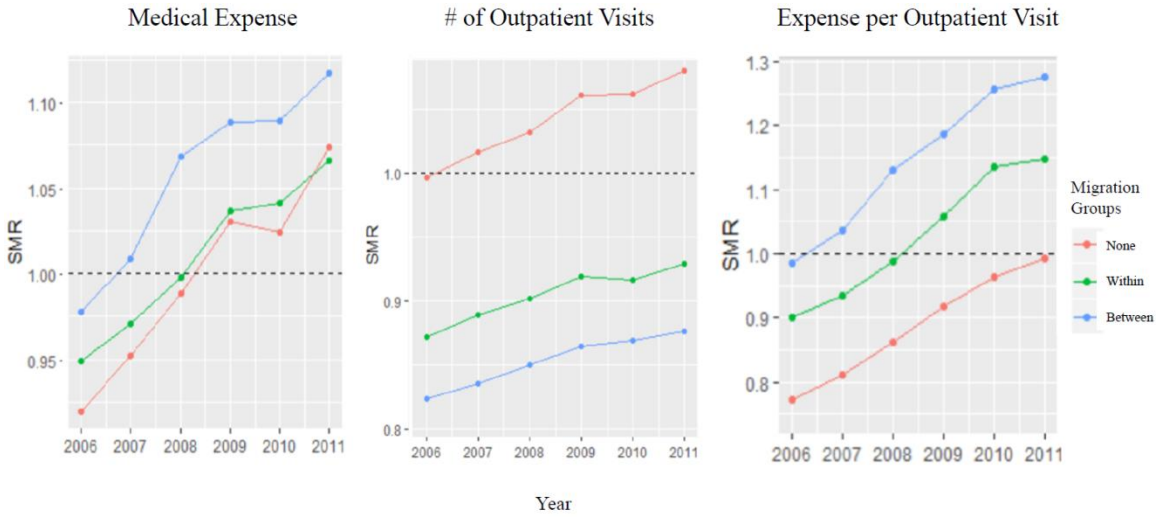


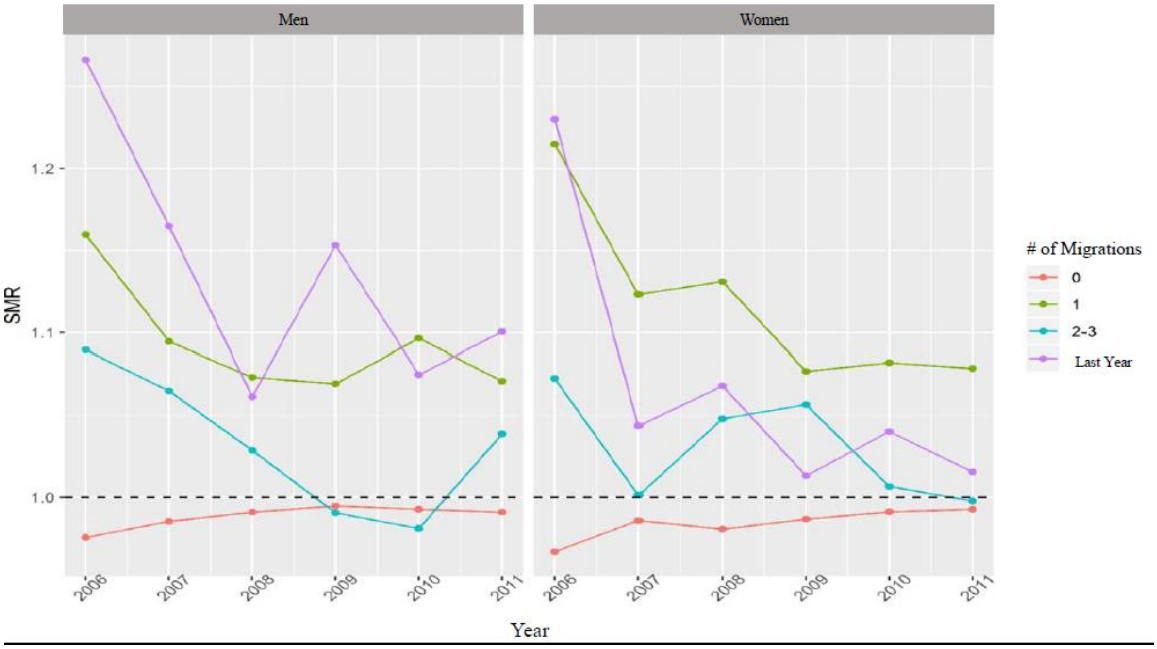
Table 4.1

BETWEEN-COUNTY MIGRATION STATISTICS OF THE ELDERLY IN 2002–2005

		Age Groups							% of Total Migrations
		65–69	70–74	75–79	80–84	85–89	90–94	95–99	
No. of Migrations	0	215,390	227,672	193,726	117,241	50,957	16,261	3,212	82.81%
	1	25,874	24,758	21,407	14,027	6,644	2,240	434	9.58
	2	18,215	16,708	13,994	8,770	4,141	1,345	300	6.38
	3	3,460	3,237	2,635	1,743	840	250	65	1.23
% of Nonmigrants		81.92%	83.59%	83.59%	82.69%	81.42%	80.92%	80.08%	

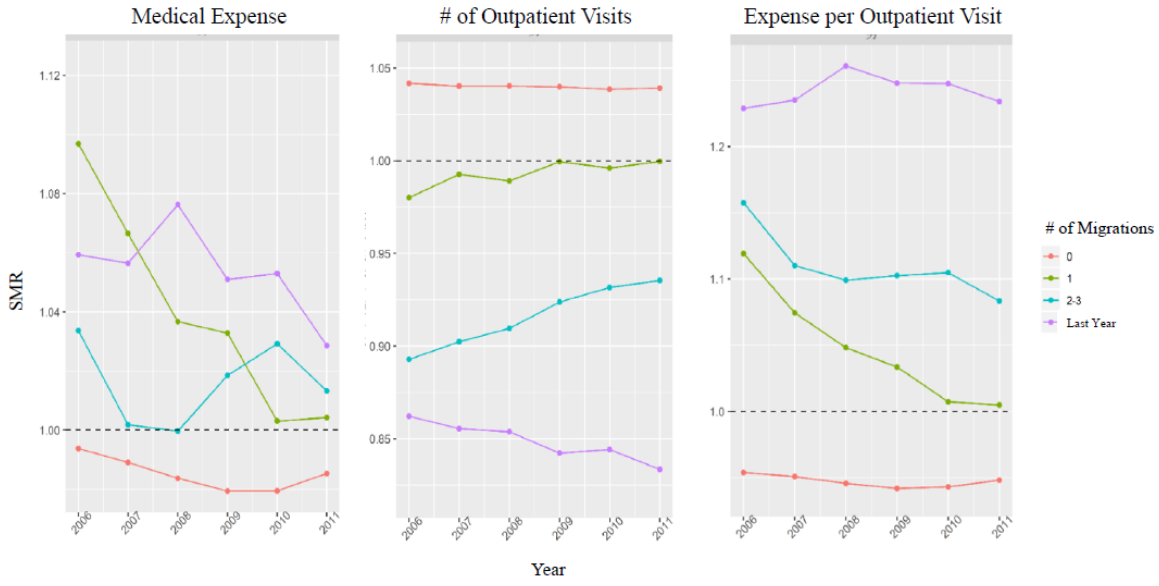
People making between-county migration have higher mortality rates, and we want to know how long the association would last. In other words, we want to explore if the idea of selection effect can be applied to between-county migration. We choose the between-county migration records in 2002–2005 to cluster the elderly, and Table 4.1 lists the numbers of people in five age groups making 0, 1, 2 and 3+ (3 and more) instances of between-county migration. We will combine the classes making two and more than two (i.e., 2+) times of migration, due to the smaller sample sizes. About 80% of each age group have no between-county migration activities.

Figure 4.4
SMR AFTER INTERNAL MIGRATION (ELDERLY)



We next compare the mortality rates and medical utilization in 2006–2011 for people making between-county migration in 2002–2005. Again we apply the notion of SMR and use the aggregate population in 2006–2011 as the reference population. Also, we use the group of making between-county migration in the last year as a reference. Figure 4.4 shows the SMRs of all groups, and we use the group of migrating in the last year as a reference. As expected, the nonmigrant group has the lowest mortality rates, but the advantage declines over time. On the other hand, the groups making one and two or more between-county migrations have higher mortality rates, and the deficit decreases as well. However, more migration leads to smaller mortality rates, which was not expected. Similarly, we anticipated that elderly men who migrated in the last year would have the highest mortality rates, but we did not expect elderly women that migrated in the last year to have lower mortality rates than those of the group making one between-county migration.

Figure 4.5
MEDICAL UTILIZATION OF VARIOUS INTERNAL MIGRATION GROUPS (ELDERLY)



We also apply the idea of SMR to calculate the medical utilization, and again the reference population is the aggregate populations in 2006–2011. The nonmigrant group has the lowest medical expense and expense per outpatient visit, whereas the group that migrated in the last year had the highest expense. The results of numbers of outpatient visits are just the opposite. However, the differences between the highest and lowest expense (and number of outpatient visits) do not change much with time. Also, we found that more migration leads to lower medical expense, which was not expected. Similar to the mortality rates, elderly men that migrated in the last year have the highest medical expenses, especially for expense per outpatient visit. For the mortality rates and medical utilization, we think that the selection effect does not apply to the between-county migration.

5. Discussion and Conclusion

Aging and migration are expected to be the two most common demographic characteristics in the 21st century. People making international migration have better health, but there is no consensus if people with internal migration have lower mortality rates. It is especially hard to predict for elderly migrants, because older people generally are less willing to travel unless they have a strong incentive. In this study we use Taiwan's National Health Insurance Research Databases (NHIRD) to evaluate if the elderly making internal migrations have longer life. We consider the medical records (outpatient visits) from the NHI to determine if individuals migrate internally and compare the mortality rates and medical utilization of elderly migrants and nonmigrants in 2005–2012.

Taiwan's domestic migration activities (of working age and elderly populations) have slowed in recent years, but the international migration activities are increasing. For internal migration, within-county (short distance) migration is more active and is less expensive. In other words, we think that there should be strong incentives for the elderly to move, especially to make between-county migrations, because the migration activity of elderly groups is less frequent (Yue et al. 2019). As expected, the mortality rates and

medical utilization are higher for internal migrants compared to those of nonmigrants. The elderly with between-county (long distance) migration have the worst health, since they have the highest mortality rates and medical expense per outpatient visit (but fewest numbers of outpatient visits). Also, we found that the selection effect does not apply to internal migration.

Our definition of internal migration is related to medical utilization, and the need of changing the place of medical care may be linked to health needs. In other words, it is likely that the migrants have more medical needs, which suggests that migrants want to improve their health. Therefore, it is no surprise that migrants (especially between-county migrants) have higher mortality rates and medical utilization. This result is different from existing results. For example, Wang et al. (2019) found that the internal migrants to Kinmen county (a remote island) have significantly lower mortality rates, according to the records from the Household Registration. It is believed that welfare policy is one of the key factors that attracts people moving to Kinmen county.

Unlike international migration, internal migration costs much less, and many factors can contribute to boosting migration activities. This makes predicting internal migration flow very difficult. For instance, people tend to move to the suburbs during a pandemic. When the coronavirus disease 2019 (COVID-19) epidemic started in early 2019, the massive internal migration from Hubei Province in China sped up the spread of COVID-19 to other major cities in China (Song et al. 2020). However, in our opinion a pandemic such as COVID-19 would have a limited impact on internal migration flow for small countries like Taiwan.

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