Variation of the Elderly Population without Public Transportation Access

—The Case Study on the Greater Tokyo Region—

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1. Introduction

Many cities in Eastern Asia are currently facing, or will soon face, the challenges of a greatly increased elderly population. One serious issue for an aging society is transportation systems. In Japan, elderly drivers are causing an increasing number of traffic accidents. To alleviate this problem, the government is encouraging elderly people to stop driving and relinquish their driver's licenses. For elderly people with no alternative mode of transportation, however, doing so would make it difficult to continue necessary daily activities, such as shopping and doctor's appointments. Therefore, estimating the number of elderly people without public transportation access is extremely important.

Thus far, many studies on elderly people without public transportation access have focused on rural areas, but sufficient studies have not been conducted on mega cities. This is mainly because the proportion of elderly people in rural areas has reached high levels much faster than in mega cities. However, some recent studies have indicated that mega cities might soon have a similar problem. In fact, some fringe areas are already showing similar signs;[1] thus, investigation into alternative mobility for elderly people is needed.

Japan is accommodating an aging society, so naturally the number of elderly people without public transportation access is increasing. However, the rate of increase in the near future is unclear. On the basis of the city-development history, some studies imply that the number of elderly people without public transportation access will grow much faster than the number of elderly as a whole. In other words, the distribution of the elderly population can be correlated with city areas' historical growth. Engels *et al*.[2] revealed that the urban sprawl of an Australian city during the 1960s and 1970s has left many elderly people unable to access trams or trains. Japanese mega cities, such as greater Tokyo, might be experiencing the same situation.

In this study, we aim to clarify how the number of elderly people without public transportation access is likely to increase in greater Tokyo. For this estimate, we used spatial and cohort analyses with national population census data from 1980 to 2010, and location on public transportation and feasible scenarios of population distribution until 2050, developed by Ariga *et* al.[3]

2. Data and Methodology

This study draws on the basis of a data set from past and future population distribution and public transportation location data in the greater Tokyo region, which includes Tokyo,

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Kanagawa, Chiba, Saitama, and the southern part of Ibaraki, as follows:

1) The national population censuses from 1980 to 2010, at five-year intervals, aggregated by cells of approximately 1 km^2 on a standard grid system.[4)]
2) Two regional population scenarios, "centralized" and "dispersed," up to 2050, at five-year intervals, developed by the "cohort change ratio method" with the base year of 2010, and two types of feasible cohort change ratios based on the change between 2005 and 2010.[3)]
3) The location data on subway and commuter railway stations from 1980 to 2010, and bus stops in 2010.[5)]

We used spatial analysis to calculate the number of elderly people without access to public transportation from 1980 to 2030, on the basis of the cohort population data aggregated by cells and locations of subway, commuter railway stations and bus stops. In this calculation, we defined elderly people without access to public transportation as those older than 65, living in cells with centers without a bus stop, and located more than 1 km from the nearest train station.

Additionally, we conducted cohort analysis, which provides the relation between past city development and the current or future distribution of the elderly without access to subway or commuter railway stations in the greater Tokyo region. This analysis is based on cohort population data from 1980 to 2010, in five-year intervals, and on the locations of subway and commuter railway stations.

3. Results and discussion

To begin with, Figure 1 shows the distribution of the elderly population and the proportion of elderly in 1980, 2010, and 2030. According to our calculations, 47% of the elderly population had no access to a train station in 2010, whereas in 1980, 39% had no access. From 1980 to 2010, the elderly population without public transportation access grew by 8% in the greater Tokyo region. Because of the growth of the elderly population as a whole and the increased proportion of elderly, the number of those without train station access increased from 1.3 million in 1980 to 4.0 million in 2010. In addition, in 2010, 4% of the 39% above had access neither to a train station, nor a bus stop. We have definitely confirmed the number of the elderly without public transportation access, as reported by the literature.

Next, we discuss projections concerning the number of elderly people likely to lack access to public transportation in the near future. In 2030, the proportion without access to a train station will be 46% in both scenarios—4.8 million people. These results suggested that in the near future, the region is likely to experience an increase in the number of elderly people without access to a train station. Therefore, to alleviate this problem, we must make policy decisions similar to those of a compact city.

Moreover, we have conducted cohort analysis to investigate how the city area's enlargement has caused distribution of the elderly population. As shown in Figure 2, the results reveal a gradual increase in each proportion of the cohort population having no access to train stations, on the basis of their migration after 1980. Figure 3 displays the cohort population with no access to train stations. Besides, those with birth years between 1936 and 1955 tend to live in places without train station access. In Japan, many people buy their homes between the ages of 20 and 40 and remain there until they are elderly. In particular, those born between 1936 and 1955 tended to do so, probably because they bought their houses during the years of an asset-inflated

economy. The city area's enlargement and motorization has given rise to an increasing preference for residing in car-friendly areas, often at some distance from a train station. Many people in such areas are now or will soon become elderly. Thus, the number of elderly people without access to public transportation is expected to increase dramatically in the near future.

Importantly, therefore, we must consider regional population distribution in advance to address transportation issues in an aging society. Compact city policies might be effective in alleviating the number of elderly people without public transportation access. Such policy will reduce both traffic accidents and social exclusion of the elderly.

4. Conclusion

In conclusion, we estimated the number of elderly people with no access to public transportation, along with spatial and cohort analyses, in the greater Tokyo region. The motorization and enlargement of city area during recent decades have brought people to live in areas with poor access to public transportation. Many will remain in these areas until they become elderly. In particular, this situation largely involves those born between 1936 and 1955. The number of elderly without public transportation was 1.3 million in 1980, 4.0 million in 2010, and will be 4.8 million in 2030.

***Keywords**: elderly people, transit, cohort, population distribution, GIS*

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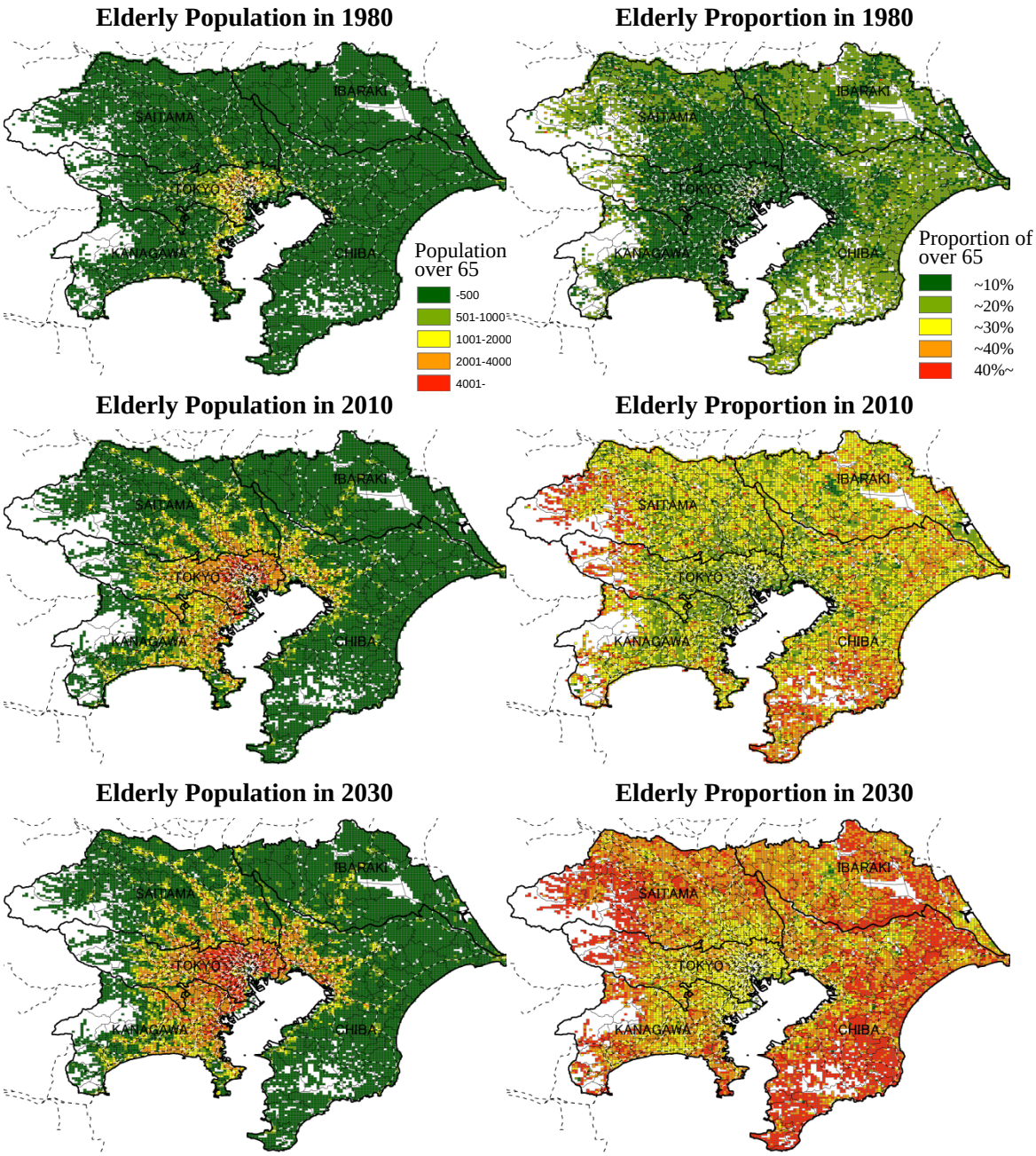

Figure1: Elderly Population Distribution in 1980, 2010, and 2030 (dispersed scenario)

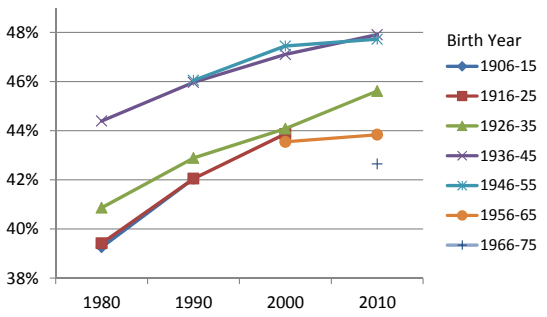

Figure2: Rate of Population without Train Station Access

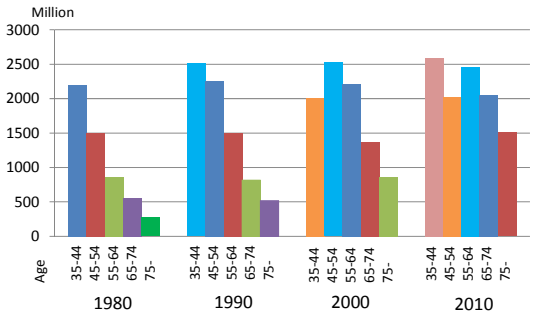

Figure3: Population without Train Station Access