

Analysis of Regional Environments Where People Certified as Requiring Nursing Care Live in Super Aging Society

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Abstract: Japan has become a super-aging society, and this is bringing with it various problems including increasing medical and nursing costs, situations in which the elderly are caring for the elderly, and so-called “nursing care refugees” . Research is urgently needed on not only the status of medical and nursing care systems, but also on the development of regions in such a way that elderly people can continue living there even when they require nursing care. This study contributes to efforts to construct efficient community-based integrated care systems by using medical-based big data called National Health Insurance Database to assess the regional environments where people certified as requiring support live on a detailed regional level of town units. We calculated the number of people certified as requiring support aged 75 or older by region, and then, we examined the relationship between the care level needs and regional characteristics quantitatively.

Keywords: National Health Insurance Data, Elderly Requiring Long Term Care, Komatsu-City, Regional Characteristics

1. INTRODUCTION

1.1 Problems in a Super-Aging Society

Japan’s average life expectancy continues to increase year by year, and the nation has already become a super-aging society—the elderly population aged 65 or older is now at the highest level in history at 34.59 million and accounts for 27.3% of the total population (aging rate) [1]. The number of people certified as requiring support/nursing care is increasing rapidly as the population ages (see Figure 1), and with a falling birthrate in addition to an aging population, the proportion of working people aged 20–64, i.e., the proportion of people supporting the elderly, is decreasing. In addition, issues such as increasing medical and nursing costs, doctor and hospital bed shortages, so-called “nursing care refugees,” and situations in which the elderly are caring for the elderly because of care worker shortages are expected to worsen from 2025 onward when the generation of approximately 8 million people born between 1947 and 1949 will become “latter-stage elderly” (aged 75 or older), and responding to these problems is

a matter of urgency [2]. These problems are collectively called "2025 problem". A review of the medical and nursing care systems will not be sufficient to deal with the 2025 Problem, and so the Ministry of Health, Labor and Welfare is promoting the construction of regional systems of comprehensive support/service provision by 2025 that will allow people, whenever possible, to continue living in the same region until the end of their lives, with the aim of preserving the dignity of elderly people and supporting independent living. This kind of system of support/service provision is called a "community-based integrated care system."

A community-based integrated care system is a "system that provides housing, medical treatment, nursing care, preventive care, and lifestyle support in an integrated manner, so that people can continue living in the same region until the end of their lives, even if they have serious nursing care needs" [4].

The state of progress of the aging population differs greatly by region such as in large cities/towns and villages. Therefore, based on regional autonomy and independence goals, community-based integrated care systems must be built according to the regional characteristics of the municipalities and prefectures that are the insurers.

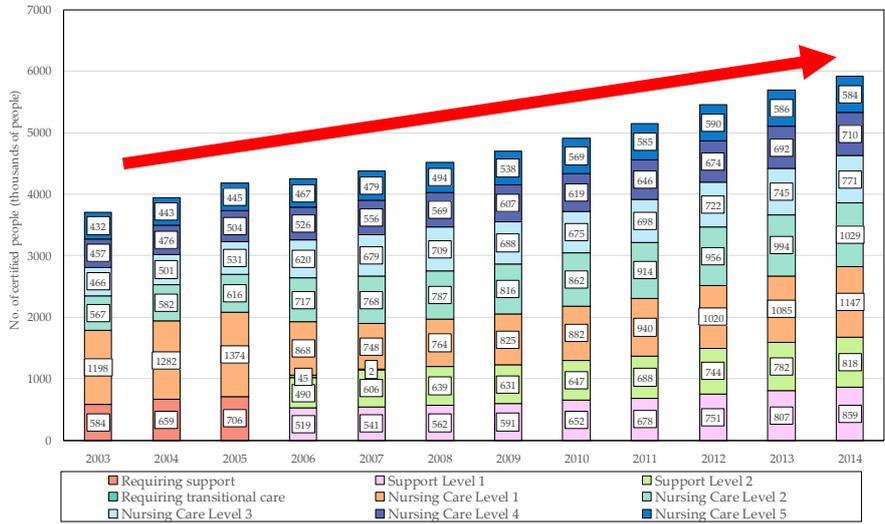


Figure 1. Changes in number of people aged 65 or older certified as requiring nursing care by care level [3]

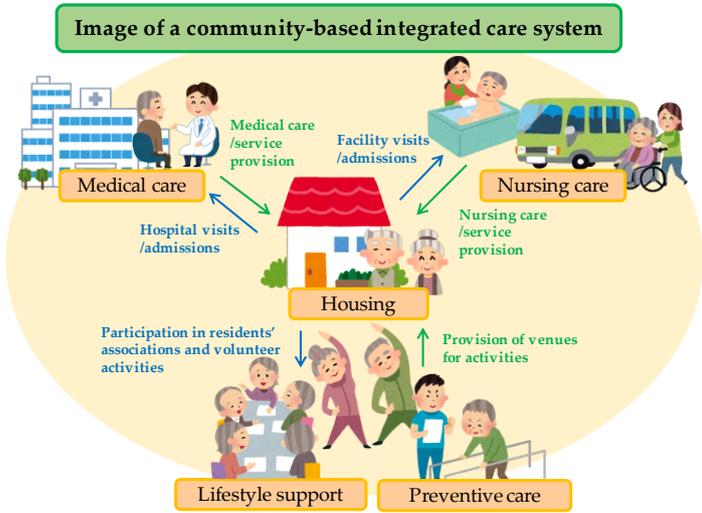


Figure 2. Components of a community-based integrated care system [4]

1.2 Purpose of This Study

As mentioned above, regional development that allows elderly people to continue living in their own homes, rather than in nursing homes, when they require support or nursing care is an important issue in Japan, which has become a super-aging society and faces various medical and nursing care problems. In addition, in Japanese welfare, it is thought that the people certified as requiring support/nursing care who is targeted of this study needs to receive care support at all levels. Therefore, this study takes as its subject people who require support in one area of their lives from among people certified as requiring support/nursing care, and medical-based big data from the National Health Insurance Database were used to compare the degree of worsening of people certified as requiring support by elementary school districts. Then, this study clarifies the effect that differences in regional environments have on the worsening of nursing care needs.

This study focuses on transportation as a factor representing the regional environment, and evaluations were made to clarify whether differences in the mode of transport habitually used affects changes in care levels. Also, to contribute to the construction of community-based integrated care systems, this study evaluated convenience of everyday life indicators in regions on a more detailed level than elementary school districts by using principal component analysis on neighborhood units called *machi/cho* or *aza*, and then, by assessing the regional environments where people certified as requiring support live, we identified regions where lifestyle support is required. Specifically, community-based integrated care systems, it is necessary to introduce living support such as bathing support, shopping support, outpatient support, and provision of venues for activities to people certified as requiring support/nursing care(see Figure 2). In this research, we aim to examine actual life condition of those people.

2. PAST RESEARCH

2.1 Research Using the National Health Insurance Database

Research using the National Health Insurance Database (KDB) by Kudo [5] highlights the possibility of using such data in the development of Data Health Plans. In Ikeda, a town in Nagano Prefecture, data from the National Health Insurance Database system are actively being utilized to develop Data Health Plans. Specifically, the town is working to promote the maintenance of citizens' health and restore the financial soundness of the National Health Insurance system by developing a plan that emphasizes the prevention of the worsening of hypertension, and Kudo [5] reported on the course of events and responses.

Takezawa and Nakamura [6] presented a summary of a data analysis aimed at promoting effective support for the elderly. The Higashi-Mikawa region in Aichi Prefecture has been preparing to implement support for the elderly over a wide area. In 2014, public health nurses in eight towns and cities carried out research for a regional diagnosis by using data from each region and the National Health Insurance Database.

Research by Morisaki et al. [7] found that capturing a region's health status in detail by using data from the National Health Insurance Database and giving guidance on health issues extracted from that information allows for more efficient and effective health guidance. Examples of research from the perspective of disaster prevention include a study by Tamamori et al. [8] on patient distribution by certified level of nursing care and by illness, and a study by Fujiu et al. [9] that assessed the situation for people requiring assistance during disasters. Also, from the perspective of medical costs, there is a study by Ogino et al. [10] on

the possibility of evaluating health levels by district.

There are several studies aimed at promoting regional health by using the National Health Insurance Database, but there has been little research on how to use data about people certified as requiring support/nursing care.

2.2 Research on Changes in Nursing Care Levels and Influencing Factors

Inoue [11] clarified the factors relating to chronological changes in required levels of care and prevention of the need for care, as well as provided predictive validity for cumulative survival rates. Of the urban-dwelling elderly people studied, 10% required nursing care, and after three years, 23.2% of those required the same level of care, while 22.2% required a lower level of care. Factors that contributed to prevention of the need for care during the three years were good subjective health, good ability to perform BADL (basic activities of daily living) and IADL (instrumental activities of daily living) and doing hobbies and other activities. In women only, a significant difference was observed in annual income and having a regular dentist. Also, the study found that the survival of the group requiring support was vulnerable to decline, and that the required level of care was an indicator with high predictive validity for survival.

Research by Murata et al. [12] examined the relationship between having basic health examinations and changes in the level of care needed by people certified as requiring nursing care/support aged 65 or older in Okutama, a town in the Tokyo area. The results showed that, compared to other levels of care required, a low proportion of the people who required support at the start were subsequently able to maintain the same level, and the size of the change was large. Regarding the relationship with having basic health examinations, people who had examinations tended to require low levels of care when they were newly certified.

Research by Takeda [13] involved a cohort study of people aged 65 or older certified as requiring nursing care/support under the nursing care insurance scheme regarding two-year survival after certification and changes in the level of care, with the aim of elucidating factors that affect the prognosis of people certified as requiring nursing care and developing measures that reduce the number of people needing care. In this study, the analysis was carried out by using the following five basic attributes: gender, age group, current address, initial level of care required, and illness requiring care. The results showed that there were twice as many survivors among the women compared to the men. There were more people whose required level of care worsened in the 80–84 age group and the 85 or older age group than in the 65–69 age group, and it was therefore assumed that the number of people requiring care will increase rapidly as the population ages. However, the more severe the initial level of care required, the fewer the survivors, and there were fewer survivors at 85 or older than at 65–69, and so it is not necessarily the case that the number of people requiring care will increase as the population ages. Also, in all of the illnesses requiring care, excluding vascular dementia, the number of people whose required level of care worsened was smaller than in the Alzheimer-type dementia group. No significant differences were found in the analysis of the current address information.

2.3 Positioning of this Research

Research that compares the degree of change in people certified as requiring support among different regions in Japan has not been carried out, and the main factors affecting regional differences in worsening of required care levels remain to be clarified. Therefore, this study can be regarded as novel in that it clarifies the factors affecting the worsening of required care levels by examining the relationship between regional environments and regional differences

in care level change as revealed by the National Health Insurance Database.

Additionally, there has been little research on the construction of community-based integrated care systems with the National Health Insurance Database. Given this situation, this study captures numerically the current status of living environments of people certified as requiring support on a detailed regional level of neighborhood units (called machi/cho or aza) by using the National Health Insurance Database, and in this regard too, this study can be regarded as novel.

3. MATERIALS AND METHODS

3.1 Overview of the National Health Insurance Database

The National Health Insurance Database was constructed with the aim of supporting insurers to implement efficient and effective health services by providing them with statistical information relating to “specific health checkups and specific health guidance,” “medical care (including care for elderly in the latter stage of life),” “nursing care insurance,” etc. managed by the Federations of National Health Insurance Organizations on behalf of insurers. Insurers implement efficient and effective health services according to service plans drawn up after identifying the health issues of local residents based on analyses of data from the National Health Insurance Database system. Insurers can then perform assessments and revise plans with the aim of resolving the next issue. Repeating this cycle can help to reduce health disparities by improving hypertension, controlling increases in patients with diabetes and reducing dyslipidemia, reducing mortality from ischemic heart disease/cerebrovascular disease, reducing new dialysis patients due to diabetic nephropathy, and also by encouraging people who have not had a health examination to have one [14]. National Health Insurance data is managed by the Ministry of Health, Labor and Welfare that supports medical care and nursing care in Japan. Information on medical care and nursing care managed by Japan is described, so "quality of data" is also secured, not content specialized to "data volume" like conventional big data.

3.2 Summary of Analysis Data

This study used the latter-stage elderly National Health Insurance Database, which contains data on elderly people aged 75 or older. Reasons for taking latter-stage elderly people as the analysis subject were related to the fact that the proportion of people certified as requiring support/nursing care increases greatly in the 75 or older age group. Also, it is difficult to assess all elderly people in the city of Komatsu by using only data from the National Health Insurance Database, which contains information about people covered by National Health Insurance up to the age of 74, because National Health Insurance coverage for ages 0–74 was only 33.0% as of September 2014. According to a Ministry of Health, Labour and Welfare survey, the National Health Insurance coverage for latter-stage elderly people was 95.7% as of October 2016.

The data used in the analysis are data on the “comparison of people requiring care (support)” in the reports outputted from the latter-stage elderly National Health Insurance Database system. The comparison of people requiring care (support) includes the data items shown in Figure 3.

Gender	Age	Date of birth (year)	Address	Diastolic blood pressure	L.D.L	Uric acid	Urinay protein	e G F R	Date of examination (ischemic heart disease)	Date of examination (renal failure)	Date of examination (dentia)	Medical treatment score	Care level	Care level (when first certified)	Start date (when first certified)	In-home (status of service use)	Facility (status of service use)	Nursing care benefits	Used service category 11	Benefits by used service category 11	Date of KDB processing	Date of examination (initially/periodontal disease)	Inpatient/outpatient category	Cost	Hypertension	Diabetes	
Female	87	502		0	0	0	0	0	24.09	0	27.07	10164		21.03	○		0	136438	0	0	201509	0		101640	0	0	
Male	81	509		0	0	0	0	0	27.07	0	0	8359		24.08	○		0	23164	0	0	201509	0		65510	●	●	
Male	81	509		0	0	0	0	0	0	0	27.07	7344		22.08	○		0	244053	0	0	201509	26.06		54070	0	0	
Female	82	508		58	80	4.8	1	58	0	0	27.07	1866		26.03	○		0	70549	0	0	201509	24.06			0	0	
Female	89	114		0	0	0	0	0	0	0	0	20194		25.03	○		0	197728	0	0	201509	0			0	0	
Female														27.03	○												
Female														24.02	○												
Female																											
Male																											
Male	85	504		0	0	0	0	0	0	0	0	3169		25.02	○		0	106738	0	0	201509	0		31690	0	0	
Female	97	106		0	0	0	0	0	0	0	0	724		12.04	○		0	225717	0	0	201509	0			0	0	
Male	83	506		0	0	0	0	0	26.12	0	0	4715		25.12	○		0	23848	0	0	201509	26.06		32570	●	●	

Figure 3. Data items used in the comparison of people requiring care (support)

3.3 Overview of Komatsu, Ishikawa Prefecture

The subject of this analysis is Komatsu, an industrial city located in the center of the Kaga Plain in the south-western part of Ishikawa Prefecture, Japan [15]. The city has an area of 371.05 km², and its total population size was 108,582 as of April 1, 2017. Currently, there are 228 machi/cho and aza, and 25 elementary school districts. Komatsu’s population is aging year by year, and the 2015 aging rate was 27.6%—this rate is higher than the national average of 26.6% [16].

4. RESULTS AND DISCUSSION

4.1 Visualization of Regional Differences in Changes in Care Levels

A total of 680 of 879 people certified as requiring Support Levels 1 or 2 between June and September 2012 were targeted for the analysis; we excluded 199 people whose information was not included in the latter-stage elderly National Health Insurance Database three years later in 2015. The scores shown in Table 1 were established for each level of care, and the average degree of change in care levels over a three-year period was calculated by elementary school district. Average degree of change in care = (Total no. of care levels changed in the three-year period)/(No. of people certified as requiring Support Level 1 or 2)

In Figure 4, which shows the results for the average degree of change in care levels calculated by elementary school district, the red-colored areas are districts with many people whose care level worsened during the three-year period, and the green-colored areas are districts with many people who maintained the same level of required support during the three-year period. This figure shows that there were regional differences in the change in care levels during the three-year period.

Table 1. Established scores by level of nursing care

Nursing care level	state	score
Support Level	1 Most basic activities of daily life can be done by oneself,	1
	2 but maintenance support is necessary to prevent deterioration of physical condition	2
Nursing care level	1 Partial care is required for daily life.	3
	2 It is a little worse from the condition of support level 1 and requires partial care.	4
	3 In daily life, almost full-time care is required	5
	4 It becomes difficult to live daily life without care	6
	5 It is impossible to live daily life without care.	7

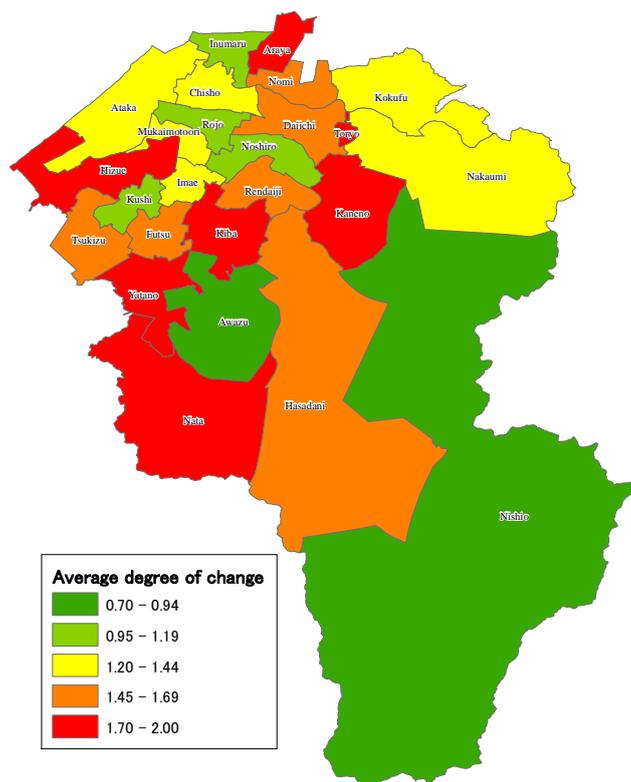


Figure 4. Average change in care level of people certified as requiring support during a three-year period by elementary school district

4.2 The Effect of Traffic Environments on Changes in Care Levels

Table 2 shows the coefficients of correlation between the average degree of change in care levels over a three-year period of people certified as requiring support, as calculated per formula (1) presented in this section, and the percentage of users by commute mode according to the 2000 census. This analysis was intended to reveal how the past lifestyle of latter-stage elderly people certified as requiring support in 2012 affected the worsening of their situation after becoming in need of support. For this purpose, correlation tests were carried out between the percentage use of “walking only, train, bus, private car, bicycle” for commuting and average degree of change in care.

The correlation coefficient for the “walking only” item was found to be significant. There was a negative correlation between average degree of change in care and walking commuter percentage, which shows that the care level of people certified as requiring support who lived in a region with a lot of walking tended to be less likely to worsen. Figure 5 shows the relationship between the two variables. Conversely, the Nishio Elementary School district had a low walking commuter percentage and yet the care level of people certified as requiring support was less likely to worsen. Also, although the correlation coefficient was not significant, there was a positive relationship between the percentage of private car use and average degree of change in care. This suggests that the care level of people certified as requiring support who lived in a region with a high percentage of private car use was more likely to worsen.

Table 2 Coefficients of correlation between percentage of users by commute mode and average degree of changes in care

Mode of transport	Walking only	Rail/train	Bus	Private car	Bicycle
Correlation coefficients	-0.4439	-0.0758	-0.0716	0.3400	-0.1881
Non-correlation test of population correlation coefficients	P-value	0.0262	0.7187	0.7337	0.0963
	* : P<0.05	*			
	** : P<0.01				

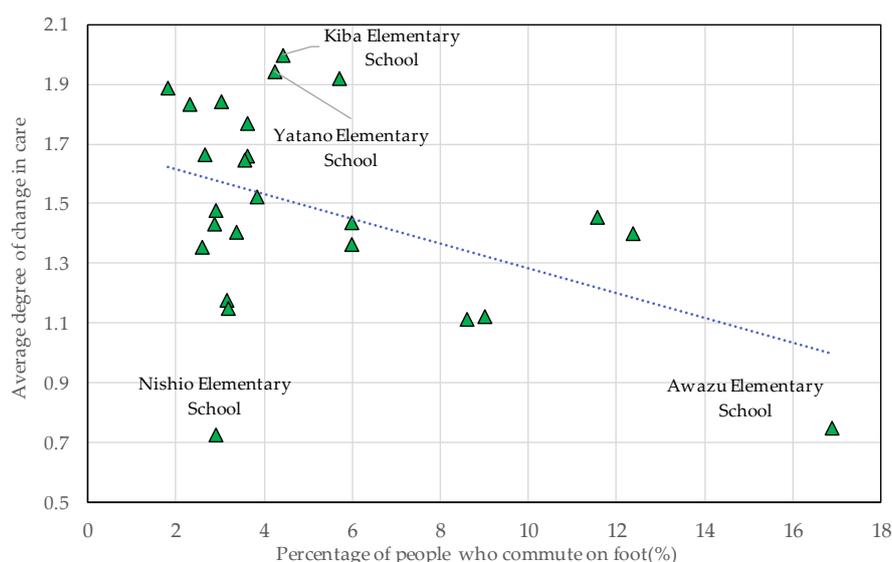


Figure 5 Relationship between average degree of changes in care and percentage of people who commute on foot

4.3 Assessment of Regional Environments Where People Certified as Requiring Support Live

A quantitative evaluation of the convenience of everyday life was carried out for each of the 228 machi/cho in the city of Komatsu. The following four variables were used in the evaluation:

- (1) Linear distance to nearest commercial facility
- (2) Linear distance to nearest medical facility (internal medicine)
- (3) Linear distance to nearest bank/credit union
- (4) Linear distance to nearest bus stop

“Transportation facilities, commercial facilities, banking facilities, and medical facilities” are most commonly mentioned as facilities required in everyday life [17], and taking the linear distance to these facilities as variables can reveal the regions where elderly people can carry out their lives primarily by walking. Variable (2) was taken as an internal medicine facility because hypertension is the main cause of hospital visits by elderly people. The convenience of everyday life in each machi/cho was quantified and evaluated by performing a principal component analysis, in which we used the shortest distance from the center of the population of the machi/cho to frequently visited places as variables.

Table 3 and Figure 6 show the results of performing a principal component analysis using variables (1) to (4). In this study, Principal Component 1, which had a contribution ratio of 49.80%, was used as an indicator of convenience of everyday life. By taking the reciprocals of the four variables used in the principal component analysis, it was possible to

demonstrate that shorter distances to the facilities were associated with higher convenience of everyday life. With regard to the principal component loadings for each variable, the highest loading was on the “linear distance to nearest medical facility (internal medicine).” This was followed by the “linear distance to nearest bank/credit union,” while the variable with the lowest loading was the “linear distance to nearest bus stop.” This shows that the distance to facilities that are frequently visited in daily life have a large influence on the convenience of everyday life.

Table 3 Eigenvalue, contribution ratio, and cumulative contribution ratio for principal components 1–4

Principal component	Eigenvalue	Contribution ratio	Cumulative contribution ratio
1	1.992	49.80%	49.80%
2	0.832	20.79%	70.60%
3	0.666	16.65%	87.24%
4	0.510	12.76%	100.00%



Figure 6 Principal component loadings for each variable in Principal Component 1

4.4 Visualization of the Convenience of Everyday Life Results

The convenience of everyday life obtained from the principal component analysis was visualized by using a geographic information system (GIS), and results were displayed on a map together with the bus routes and bus stops in Komatsu. The region with the lowest convenience had a score of -1.54, while the highest score was 6.08, which indicates that the convenience of everyday life in Komatsu differs greatly by region. As shown in Figure 7, convenience was high in downtown Komatsu and in regions along bus routes; however, it was low in mountainous regions distant from the downtown area, even if bus routes did exist there.

The number of latter-stage elderly people certified as requiring Support Levels 1 or 2 in September 2015 in Komatsu was 957. Figure 8 shows the distribution of the number of people certified as requiring support. The region with the highest number had 53 people certified as requiring support, while there were also many machi/cho with no people certified as requiring support.

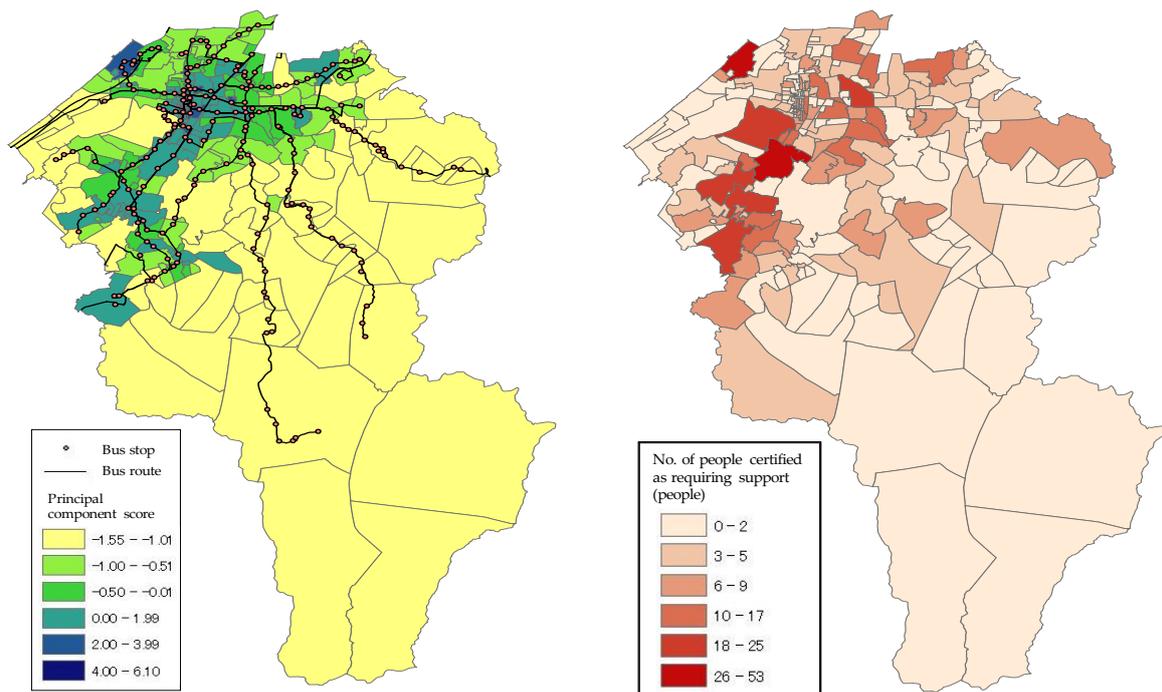


Figure 7 Visualization of convenience of everyday life and bus routes and Figure 8 Distribution of number of people certified as requiring Support Levels 1 and 2

4.5 Relationship between the Convenience of Everyday Life and Number of People Certified as Requiring Support

Figure 8 shows the relationship between the convenience of everyday life and the number of people certified as requiring support. The figure shows that in regions with few people certified as requiring support and high convenience of everyday life, people can live independently in the region even if they require support. However, in regions with many people certified as requiring support and low convenience of everyday life, it is difficult for elderly people to live on their own. In these regions, the cooperation and support, not only of family, but also of people living in the region is considered necessary.

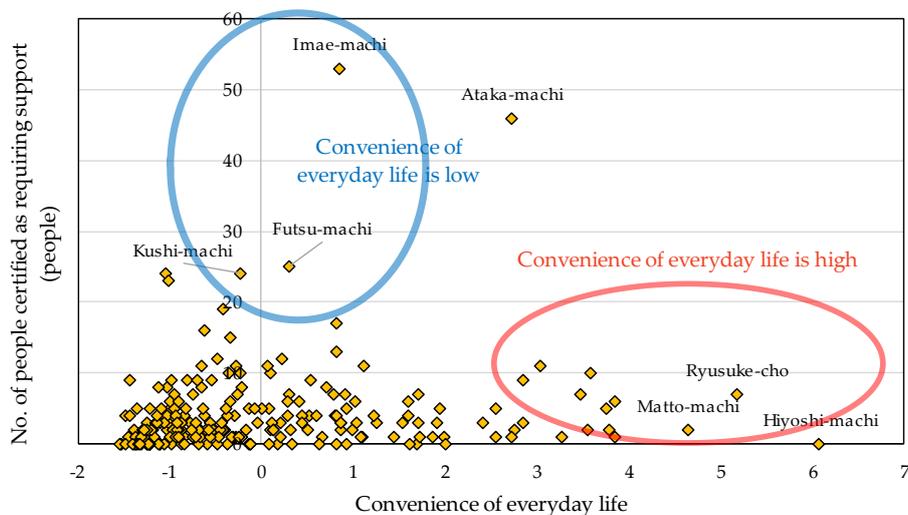


Figure 8 Convenience of everyday life in different regions and number of people certified as requiring support

5. CONCLUSIONS

As a result of analyzing the relationship between the percentage of users by commute mode and change in care levels over a three-year period of people certified as requiring support by elementary school district, we identified commuting on foot as a factor affecting the change in care levels. The results showed that elderly people who used to travel on foot rather than by private car in their daily lives, after becoming in need of support, were less likely to worsen and require nursing care. Also, we performed a visualization of the convenience of everyday life in regions on the level of neighborhood units (called machi/cho and aza) by conducting a principal component analysis, while taking distance to facilities required in everyday life as variables. In this study, it was possible to examine the actual condition from the viewpoint of the life convenience of people certified as requiring support care living in area.

This study evaluated the convenience of everyday life by using the distance between where people live and medical facilities, commercial facilities, financial institutions, and bus stops as variables, but it may be insufficient to evaluate convenience by distance alone. Frequency of use and means of transportation to a facility must also be taken into account. Also, regarding the influence on the worsening of required care levels, the degree of worsening can differ as a result of interactions among multiple factors. Hereafter, by using the results of a questionnaire survey of Komatsu residents, we intend to clarify how each regional factor affects the worsening of required care levels by assessing the current situation of people's lives in each region. In this study, we focused only on the three-year deterioration degree of people certified as requiring support care living in the community. Age, gender, medical history, etc. can be considered as factors in deterioration of the care level. In the future, analysis will be conducted that considered the factors.

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