

A STUDY ON THE FREQUENCY OF MOVEMENTS IN A MOUNTAINOUS REGION FOCUSING ON AGE-GROUP AND AREAS OF ACTIVITIES

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ABSTRACT: A survey by questionnaire was conducted to study the frequency and range of movement of residents in Niyodogawa-cho, Kochi Prefecture, located in a mountainous region. The result is classified by age group. It is confirmed that the frequency and the range of activities differ by age group: the higher the age, the lower the frequency. It is predicted from the results that the situation rapidly changes in a rapidly aging mountainous region.

KEYWORDS: mountainous region, travel frequency, activity range

1. INTRODUCTION

The populations in Japan's mountainous regions are rapidly aging, declining in numbers, and experiencing falling birthrates. One of these regions, Niyodogawa-cho town in Kochi Prefecture, is the subject of this study. The town's current population is one-third the level of five decades ago, and the proportion of the elderly (65 years old and older) approaching 50%. The town is on the verge of becoming a "marginal community"¹ (Figure 1), which means that it is having difficulty maintaining a social community because the majority of its citizens are elderly.

A number of studies and reports have examined the living conditions and revitalization activities in unsustainable villages and discussed the sustainability of villages.^{2, 3} Some studies of the infrastructure that supports community life have examined the activities of daily living, the residents' perceptions of local transportation systems, and the potential for introducing new transportation services.⁴ The effects of investments in roads and other social infrastructure improvements tend to be

underestimated because of the smaller traffic volume (users) in villages relative to that in urban areas.^{5,6} The inconvenience associated with roads and other transportation systems is the primary reason why rural villages are abandoned.² In order to discuss how to prevent the loss of sustainability in rural villages and the strategies for abandoning villages in mountainous regions, it is essential to understand not only the villagers' current activities of daily living but also their likely behavior in the future.

Hirai investigated travelling by the elderly in mountainous agricultural regions and urban areas.⁷ The study examined the frequency, means, and destinations by travel purposes in order to identify issues related to the travel constraints that they face. Okuno et al. surveyed the activities of daily living of people in mountainous regions. The survey revealed a higher dependence on vehicles and a higher frequency of travelling by those with unlimited access to a vehicle than by those without a driver's license.⁸ However, these studies did not analyze the living conditions and activity ranges according to age in regions with rapidly aging populations. The

studies also failed to predict the future activities of the residents.

This study investigated the activity ranges (travel outside the home) of people in a mountainous region and how frequently they travelled and used the results to predict future behavior. The specific approach was a questionnaire given to the residents of Niyodogawa-cho, a town in a mountainous region of Kochi Prefecture. The aim of the survey was to determine travel frequency by activity range and age group. For this purpose, considering the sparse distribution of villages, which is typical of mountainous regions, the activity ranges were divided into three categories: travel in the vicinity of the villages in which they lived, travel outside the vicinity of the town, and travel outside the town. This revealed the travel frequency by activity range and age group of the residents in this mountainous region. Combining the findings from this survey of age groups and a projection of future demographics, the future activity ranges and travel frequencies were estimated using a simple method, and some analysis was attempted.

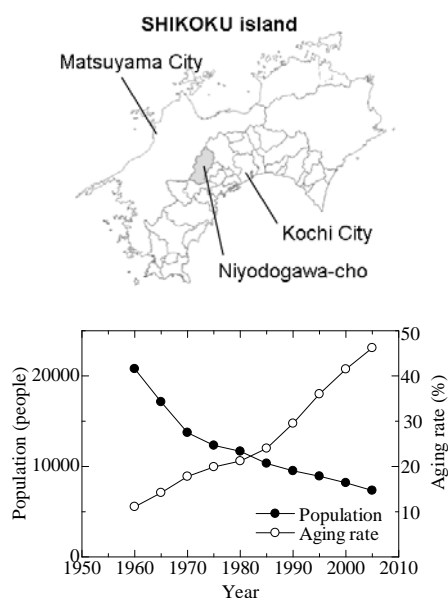


Figure 1. Trends in population and aging rates in Niyodogawa-cho, Kochi Prefecture.¹

2. OVERVIEW OF INVESTIGATION

2.1 Scope and methodology

The questionnaire was sent by mail to all of the households in Niyodogawa-cho (3,253 households) in late November 2009. The responses were collected until the end of March 2010. Each household was sent two questionnaires, one for the head of the household and one for another person in the household. The survey consisted primarily of questions about household composition, travel outside the home, the convenience and dangers of the roads, and the current and future situations of the villages in which they lived. This study examined the following subjects:

- Individual attributes: gender, age, driver's license, unlimited access to a vehicle, etc.
- Travel frequency and means of travel, categorized by activity range (discussed below)
- Reasons why travel is inconvenient, categorized by activity range (discussed below)

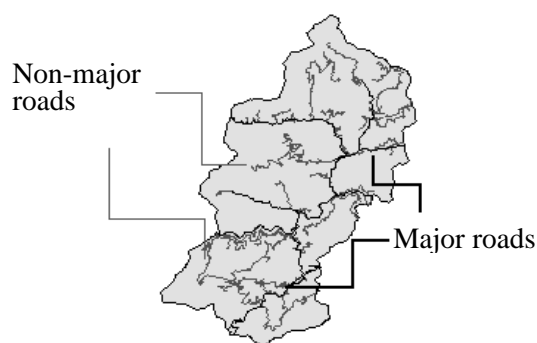


Figure 2. Roads in Niyodogawa-cho.

The activity ranges were divided into three categories, as previously noted. Niyodogawa-cho town is characterized by an intricate crisscrossing of local roads (excepting major national roads), as shown in Figure 2, and is dotted with villages. In light of this situation, the residents' activity ranges are “the vicinity of the home” (a radius of two to

three minutes by car), “outside the vicinity of the town,” and “outside the town.” These categories were used to determine which questions to ask regarding the above subjects.

2.2. Collection of data

The survey return rate was about 19.7%. This study analyzed 1,025 responses from 642 households. The ratio of male respondents was 50.7%. The basic residential registers show that the population of Niyodogawa-cho was 7,171 as of February 2009. Therefore, the survey respondents comprised about 14.3% of the town's population. Figure 3 shows the age distributions for the 988 respondents who provided their age and for the entire population of the town. Since only the head and one other member of the household were asked to provide their ages, the age distribution range was relatively high, between 55 and 84 years, with an average age of 66.9 years. Dividing the population into age groups, 387 people (39%) were 64 or under, 296 people (30%) were between 65 and 74, 242 people (25%) were between 75 and 84, and 63 people (6%) were 85 or above. This allowed the data to be analyzed by age group.

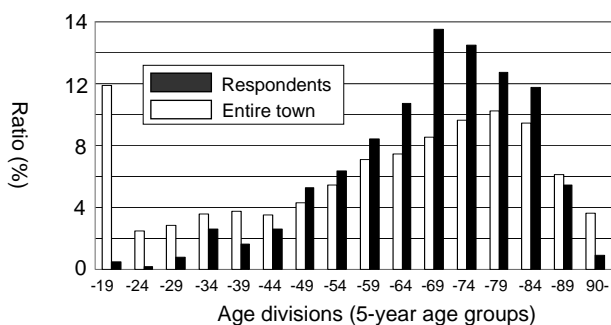


Figure 3. Age distribution of respondents and entire town.

3. BASIC ANALYSIS

3.1 Ownership of vehicle, and travel means

Figure 4 shows the ratios of respondents with a driver's license and a vehicle according to age group.

72.1% have a driver's license, while 68.5% own a vehicle. Nearly every respondent up to the age of 64 has a driver's license and owns a vehicle (89.2%). This ratio is significantly lower for those aged 65 or above (54.7%). Even those 75 and above, who are now considered to be late-stage elderly, own and drive a vehicle if they have a driver's license. This matches the results of the study by Okuno et al.⁸ As for travel means, for which multiple answers were allowed, Figure 5 shows that most vehicle owners prefer traveling by vehicle, even for travel in the immediate vicinity. Comparing this result with the findings⁷ by Hirai on the means of travel for grocery shopping in the immediate vicinity of the home in mountainous agricultural regions, Niyodogawa-cho's residents still show a high dependence on vehicles, possibly due to the town's steep terrain. On the other hand, people who do not own a vehicle have no choice but to share a ride in a vehicle driven by a family member, walk, and/or use public transportation.

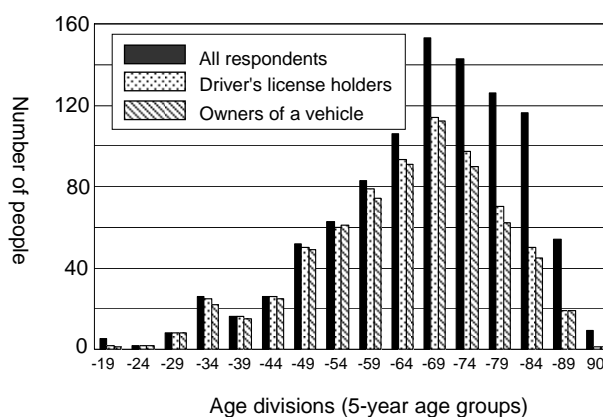


Figure 4. Driver's license and vehicle ownership.

3.2 Travel frequency by age group and activity range

To clarify the residents' travel behavior in this mountainous region, the survey asked about the travel frequency for each activity range. Considering the results described in the previous section, which

indicated that the convenience of travel varies with access to a vehicle, the responses were aggregated according to such access. The provided answer options were daily, 2-3 times per week, once per week, once per month, and other.

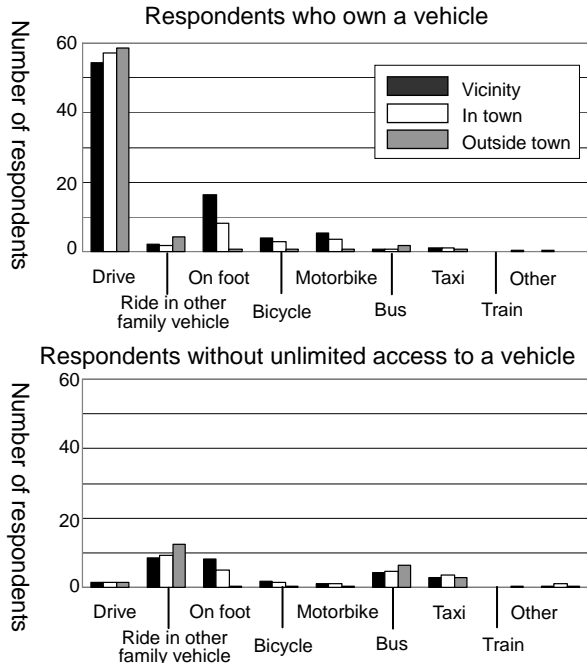


Figure 5. Travel means.

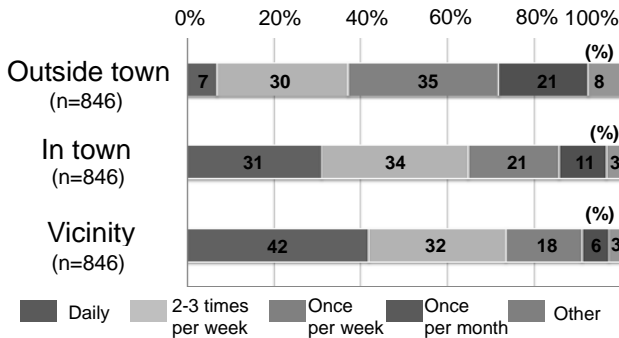


Figure 6. Travel frequency by activity range.

Table 1. Data on the number of respondents.

(Unit: people)

Age	Owns vehicle	Does not own vehicle	Total
64 and under	333	27	360
65-74	188	62	250
75-84	98	77	175
85 and above	34	27	61

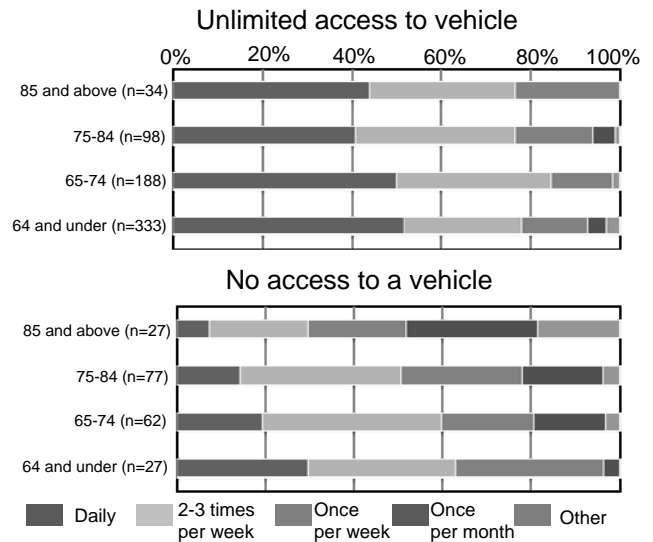


Figure 7. Travel frequency in vicinity of home.

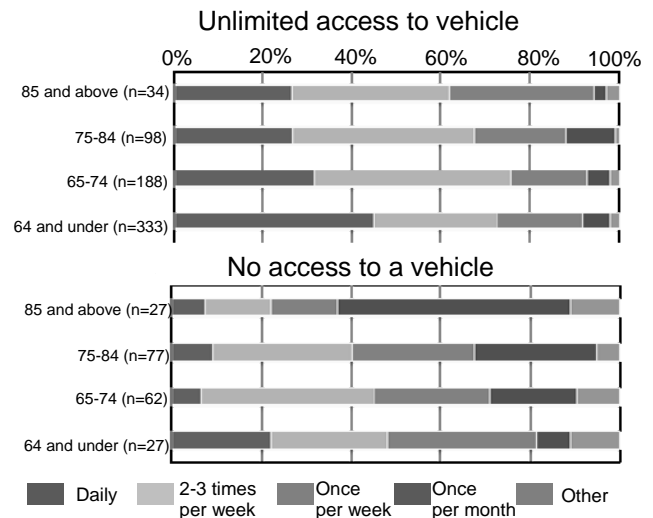


Figure 8. Travel frequency outside vicinity of town.

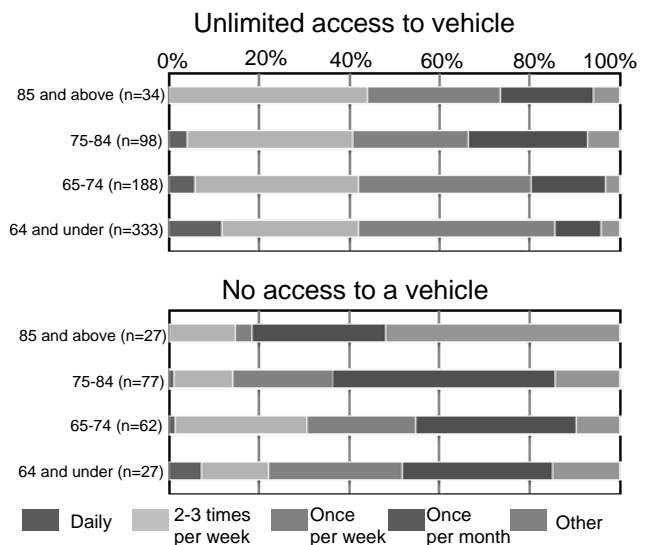


Figure 9. Travel frequency outside town.

Figure 6 shows the travel frequencies by activity range based on the data from the 846 respondents who answered all of the inquiries. As for travel in the vicinity, “daily” had the highest ratio. The other ratios decreased as the frequency became low. As for travel outside the vicinity in the town, “2-3 times per week” outnumbered “daily.” The remaining travel frequency ratios fell as the frequency decreased. For travel outside the town, “once per week” had the most responses. These findings confirmed frequent travelling in the vicinity of the home and less frequent travelling of longer distances.

Next, the data was analyzed according to age group and unlimited access to a vehicle. The ages were divided into four groups: 64 and under, 65-74, 75-84, and 85 and above. Table 1 lists the responses by attribute. Although little data was collected for those aged 64 and under and those aged 85 and above who don't own a vehicle, studies and predictions will be attempted and will continue into the next chapter. Figures 7-9 show the travel frequency for each activity range by age group and unlimited access to a vehicle.

The travel frequency for vehicle owners was examined. For travel in the vicinity of the home, “daily” was the most commonly given answer in any age group, and the ratios decreased as the travel frequency fell. As for travel outside the vicinity of the town, “daily” is predominant among residents 64 and under, which is higher than the overall trend. (Figure 6) Moreover, over 60% of those 75 and above travel farther than the vicinity of the town two to three times per week. Overall, the travel frequency declined as the travel distance grew, and the more advanced the age, the less frequent the travel.

In contrast, people with no access to a vehicle showed a different tendency. For travel in the

vicinity of the home, “2-3 times per week” exceeded “daily,” clearly indicating that this group travels less frequently than do vehicle owners. Of people 85 and above, many selected “once per month,” even for travel in the vicinity of the home, which is the opposite tendency of those who own a vehicle. This could be attributed to the steep geography of the mountainous villages, which makes travel difficult even in the vicinity of the home and may be a reason to avoid travel by means other than vehicles. The specific characteristics of mountainous regions can be clarified by conducting similar studies in plains regions and comparing the results with those of this study.

As for travel within the town, “2-3 times” or “once per week” were selected by the largest number of respondents, which indicates they travel less frequently than those who own vehicle owners. People 64 and under answered “daily” more than other age groups, which may be because they have jobs outside the home. As for travel outside the town, “once per month” is the answer most often selected among all age groups. Furthermore, in the age group of people 85 and above, the largest number of people selected “other,” and more than half of these indicated that they travel only a few times a year or once every few months.

Regarding reasons for the inconvenience that people feel in terms of travel means, the answer options were “physically challenging,” “unable to drive,” “few bus runs,” “road congestion,” “other,” and “do not feel inconvenienced,” from which the subjects were asked to select one for each activity range. Figure 10 shows the ratios for the answers by activity range and age group. The answer of “do not feel inconvenience” is prominent, but as the age advances, “physically challenging” increases. Moreover, for travel in and outside the town, all age

groups expressed complaints about the frequency of bus service. This suggests the possibility that poor public transportation contributed to the dependency on vehicles. About 40% of the people without a driver's license cite their inability to drive as a factor for the inconvenience they feel. Of the respondents who do not feel inconvenienced, several noted in the free-comment box that "they do not feel inconvenienced so long as they can drive." More specifically, Figures 7-9 show that the great variation among age groups in travel frequency for those without a vehicle is due to the proportion of residents who feel travelling is physically difficult, which increases with age, and when they become unable to drive a vehicle, their travel frequency is directly affected.

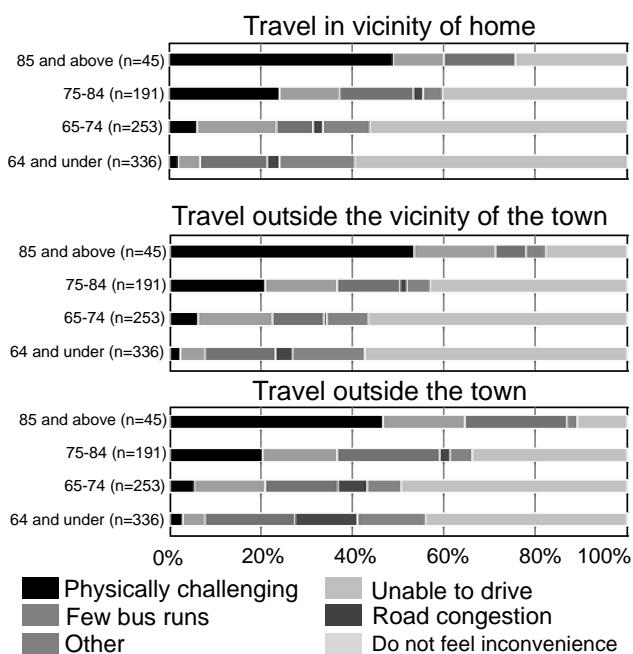


Figure 10. Inconvenience associated with travel outside the home.

Among the residents in this mountainous region, travel frequency differs with activity range, age group, and unlimited access to a vehicle. Specifically, travel situations worsen as the resident ages, and the trend will fluctuate depending on the town's age demographics., Future travel frequency is estimated

and analyzed in the next chapter based on the data obtained in this study

4. FUTURE PROJECTIONS ON TRAVEL FREQUENCY

4.1 Procedures for calculating the projections

In this section, travel frequency for the whole town is projected for the three activity ranges described earlier, factoring in future demographics, for the years 2010 (current state), 2020, and 2030. The age groups are the same four groups described in the previous chapter, however, the scope of these projections is limited to those aged 20 and above, since the volume of responses from people under 20 was small and vehicles will be the major means of travel.

A frequency model such as an Ordered Logit Model could have been used for the projections, but this study employed a simpler process. The age divisions (5-year age groups for the period of the prediction years) were established using the projected data for each municipality⁹ as compiled by the National Institute of Population and Social Security Research. (Table 2) Moreover, in determining the proportions of residents in each 5-year age group with unlimited access to a vehicle in the future, it was assumed that the proportional patterns identified in this survey (2010) would hold true in their entirety and not change in the future. For instance, the proportion of residents in the 55-59 year-old group with unlimited access to a vehicle will apply to the proportion of residents in the 65-69 year-old group in of 2020 and to the proportion of residents in the 75-79 year-old group in of 2030. Consequently, the future ratios for elderly with unlimited access to a vehicle will be higher than today's ratios. Not taken into account are possible changes in the proportions resulting from relinquished driver's licenses and other reasons.

Finally, based on the assumption that the travel frequency patterns in each age group will not change, future travel frequency by activity range is determined by multiplying the travel frequency ratios in each age group (Figures 7-9) by the population.

4.2 Estimation results

Figure 11 shows travel frequency projections by activity range for the town's residents. Histograms are similar to current ones (2010) and show no noticeable changes over time. Specifically, travel frequency declines with age, while travel tendency by activity range remains unchanged.

Table 2. Population estimates.

(Unit: people)

Age	2010	2020	2030
0-19	745	497	318
20-64	2572	1741	1272
65-74	1199	932	574
75-84	1373	987	790
85 and above	654	841	736
Total	6543	4998	3690
Aging ratio	49%	55%	57%



Figure 11. Projected travel frequency.

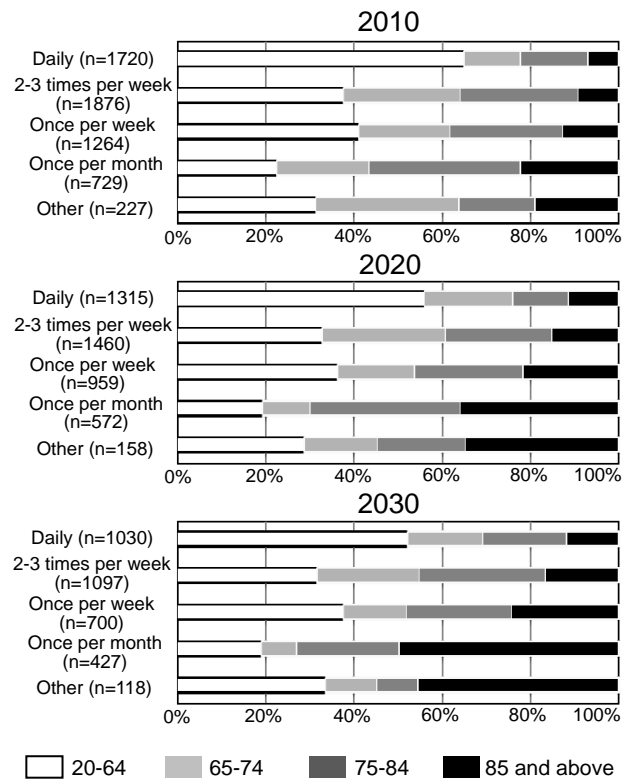


Figure 12. Travel frequency outside the vicinity of town by age.

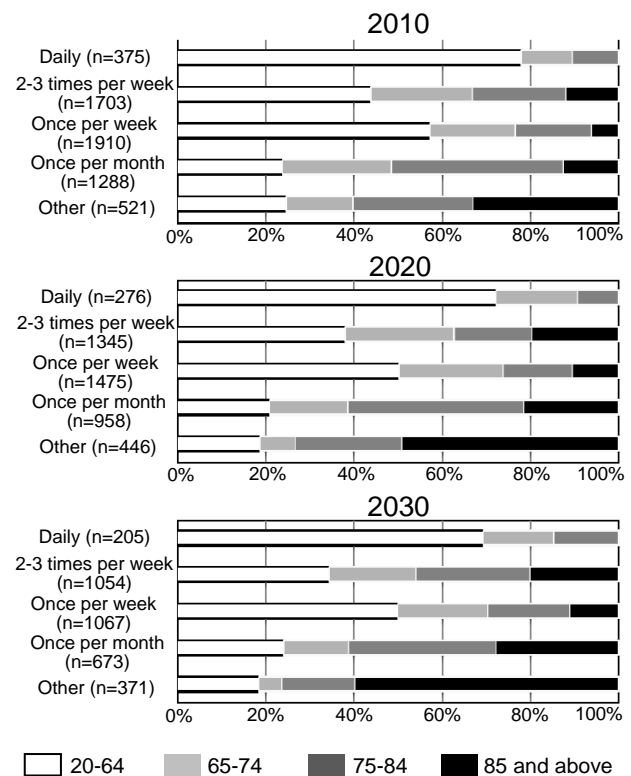


Figure 13. Travel frequency outside the town by age.

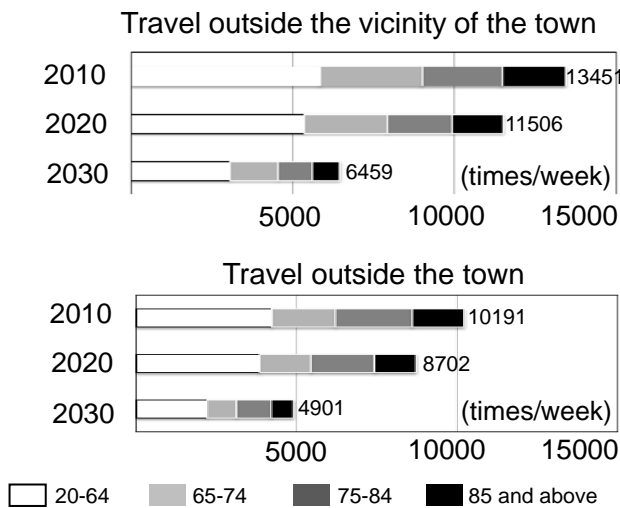


Figure 14. Predictions of travel volume.

Next, the age group proportions by travel frequency were examined. (Figure 12. Travel in town, and Figure 13. Travel outside town; "Travel in the vicinity of the home" is omitted because it has a composition very similar to that of "Travel in town.") Figure 12 (Travel in town) shows that the proportion of the elderly is projected to grow in the future and will reach 50% or higher in all categories of travel frequency by 2030. Notably, those 75 and above will account for about half of the "once per week" category by 2020, and by the year 2030, people 85 and above will constitute about half of the "once per month" category. Thus, the ratio of elderly drivers is expected to increase. Figure 13 shows a tendency for those 75 and above to travel outside town less frequently, although the tendency is not as obvious as that observed in the "Travel in town" category.

The travel frequencies are converted into weekly figures (for instance, every day → 5 days/week,, once per month → 0.25 days/week, other → outside the scope) in order to calculate the total travel volume, as shown in Figure 14. For travel both inside and outside town, the frequencies are estimated to decline from the current levels to 85%

in 2020 and 48% in 2030, indicating a rapid decline similar to the decline in population. This study assumed that vehicles were the major travel means. Because of the higher proportion of the aged people, however, the need for improved public transportation, such as fixed-route bus services, is likely to grow in the future, even though the number of potential users seems to be extremely small. The introduction of on-demand buses, grocery trucks, etc., is one possible solution, but this remains a very serious issue for efforts to maintain living standards in mountainous regions.

5. CONCLUSIONS

The results of a questionnaire given to the residents of Niyodogawa-cho, Kochi Prefecture were analyzed and used to predict future trends. The conclusions are summarized below.

1. An investigation of activities revealed that the residents in this steep mountainous region primarily use vehicles for travelling, even in the immediate vicinity.

2. An analysis of travel frequency by age group and activity range revealed the following:

- Remarkably unlike those with unlimited access to a vehicle, people with no access to a vehicle travel infrequently even in the immediate vicinity.

- Travel frequency depends on unlimited access to a vehicle, and the disparity in travel frequency between those with unlimited access and those with no access increases with age. Analysis according to age group is essential for understanding travel behavior.

- Regarding the inconvenience associated with travel, physical difficulties among the elderly are a primary factor for decreased travel frequency, with the ratio significantly high among the late-stage elderly (75 and above).

3. Using a simple projection technique to obtain the travel frequency and total number of trips for the

entire town, the study quantitatively confirmed the rise in the number of elderly drivers along with the need for, and limitations to, new public transportation services to retain current living standards.

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