

Study on the Style of Urban Development as a Center of Kitakyushu Monorail

—About the User Actual Situation and the Demographic around the Station

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Abstract

The ageing of the population in Japan has become a problem. According to the research of different regions, where the ratio of the ageing population is above 25%, it is found that the Japanese society is gradually turned to hyper-aged society. The population along Kitakyushu monorail is also in such a situation. This study is based on the background, with excessive reliance on their own vehicles and public transport problems arising from the abolition of public transportation in Kitakyushu as the area of this study. Under the full consideration of people who can't drive, the elderly who had to take buses as well as people who lack of transport ability where population decrease and the aging problem have been worsening, their surrounding environment should be further improved. In addition, it should be taken into consideration to increase the population in the walking distance around the stations.

Keywords

Monorail, Population, Hyper-Aged Society, Aging Ratios

1. Introduction

Ageing of the population in Japan has become a problem and Kitakyushu is no exception. From the year 1995 (during the year 1995, people over 65 accounts for 15.7% of the population) and in the year 2010, the number revealed an increasing tendency. (Till the September of the year 2010, people aged 65 or above accounts for 19% of the population) According to different regionally statistical data, regions with the ratio of the ageing popula-

tion above 25% are gradually turned to hyper-aged society. The population along the Kitakyushu monorail [1] is also in such a situation. As the ratio of working people (from the age 15 to 64 years old) is reduced, the traffic is correspondingly reduced.

This study is based on the background that is people excessively rely on their own vehicles, and much public transportation [2] [3] has been abolished. Kitakyushu, the areas of this study, is facing the same problem. Under the full consideration of people who can't drive, the elderly who had to take buses as well as people who lack of transport ability, we conduct a survey in form of questionnaire investigation on the people who lived and used the monorail. From the questionnaire we can find and solve the problem to enhance the capacity of public transit.

2. Literature Review

Tachikawa Minoru and Nisiura Sadatuqu studied on the influences of public transportation on land and building uses: The case of Tama Monorail Line [4]. In that study, author investigate the land building use of the consideration area for and the change as a case study in the Tama area that assumed Tama Monorail Line of Tokyo an axis in detail and build the result as a database. The authors investigate the terms of reference for a range of distance 500 m from the station where it is thought that a person uses Tama Monorail Line.

Kohei Matsumoto and Shuichi Murakami studied on re-evaluation of the Abandoned Monorail Structures as Urban Landscape Elements. That paper through a case of the abandoned monorail structures in the city of Himeji [5]. The remaining structures were measured of their height, width, location, and visibility from the streets around the located areas [6] [7]. Owners and uses of the lots accessibility from the surroundings and evidences and traces showing and uses of the structures were also investigated. The result shows the ruins' two sides of potential values, to be seen and to be used, as one of the urban landscape elements.

Junyi Shen *et al.* studied the influence of environmental deterioration and network improvement on transport modal choice [8]. That paper examines how these impacts affect individuals' decisions on selecting transport mode under an extension plan for the Osaka Monorail Loop-line. To estimate these impacts, they perform a Stated Choice experiment for collecting data in the neighborhood along the monorail's extended line. They estimate their model with the Heteroskedastic Extreme Value specification in order to avoid the Independence of Irrelevant Alternatives assumption in the Multinomial Logit model [9]. Both the results of full-sample and sub-sample data imply that residents prefer public transport modes (monorail or bus) to private cars when either the natural environment becomes worse or the transport network improves.

The difference between the present research and the above-mentioned study is that they were studied the land building use of the consideration area and the re-evaluation of the abandoned monorail structure as urban landscape. Tachikawa Minoru *et al.* investigate the terms of reference for a range of distance 500 m from the station. The present research is based on the long-distance range (500 m) and short-distance range (200 m) with the monorail station as the centre. It investigates the aging problem of the population in the areas surrounding the Kitakyushu monorail and the utilization situation of the monorail.

3. Population Characteristics of People along the Monorail in Kitakyushu

Figure 1 shows the variation trend of public transportation in Kitakyushu. According to the graph, after reaching the climax in the first half of the year in 1965 [10], the number of people taking the public transport has been in a general decline in Kitakyushu. Influenced by the suspension of Kyushu Line of Nishitetsu (streetcar), the number of people taking buses has declined dramatically from 2000 to 2006. The number of people taking JR, monorail and Chikuho rail has also shown a declining trend in recent years. Besides, the number of private cars has increased to a certain extent.

3.1. The Population Predictions along the Monorail in Kitakyushu

Seen from the population structures in the areas along the monorail in 2005 (**Figure 2**), the number of people aged between 30 and 40 was 7400 as the most. From the population distribution in 2010 (**Figure 3**), the number of people between 35 and 39 was 6831, which is also the most. From 2005 to 2010, the population in the surrounding areas along the monorail declined from 86,933 to 86,311, and the ratio of people aged more than 65 increased from 17% to 19%. Since the population change of various age groups from 2005 to 2010 is known,

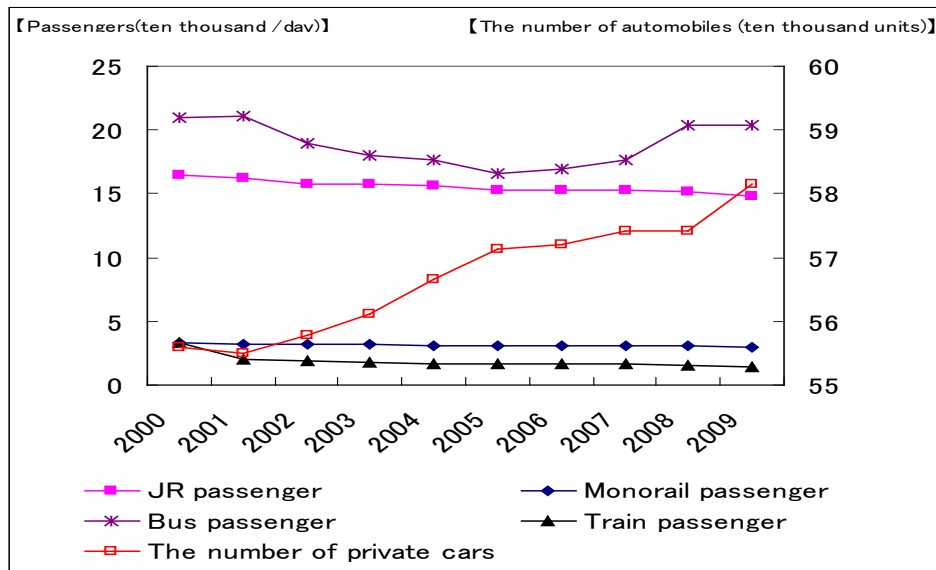


Figure 1. The situation of public transportation in Kitakyushu.

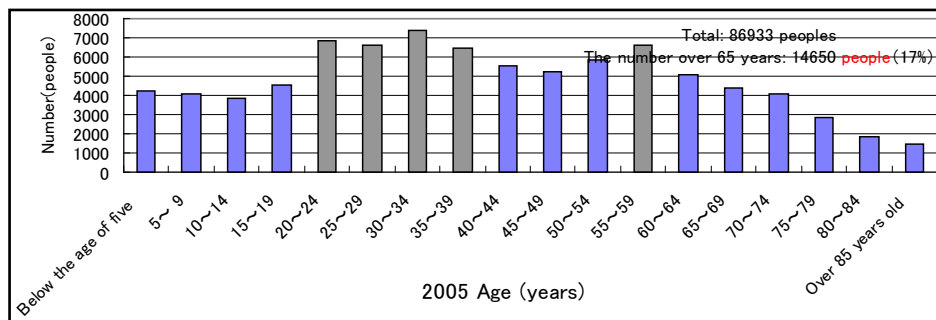


Figure 2. The population structures in 2005.

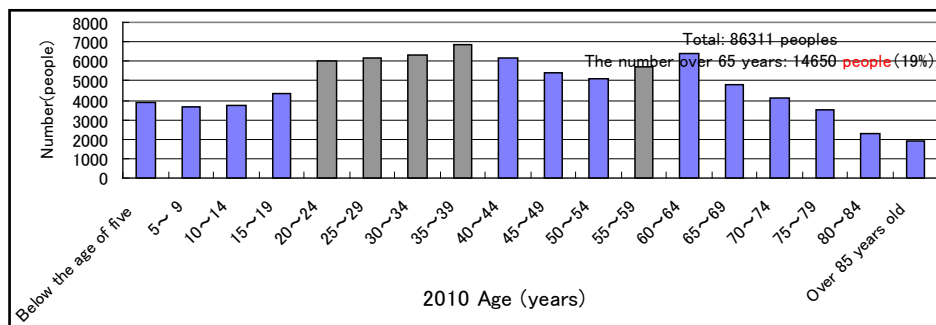


Figure 3. The population structures in 2010.

assuming that the population change from 2010 to 2015 is in the same increase or decrease as that from 2005 to 2010, the population of 2015 (Figure 4) and 2020 (Figure 5) can be forecasted by analogy.

According to the speculations, from the year 2010 to 2020, the population in the surrounding areas along the monorail will decline from 86,311 to 83,130, and the ratio of people aged more than 65 will increase from 19% to 25%. Then the aging society will come.

3.2. Changes of the Aging Ratios in the Areas along the Monorail

This study is based on the long-distance range (Figure 6) (each station as a centre, 500 meters as the radius) and

short-distance range (each station as a centre, 200 meters as the radius) with the monorail station as the centre. The aging ratio of each station will increase year by year. By 2020, the ratio of the people aged more than 65 of each station will have reached the climax, which will be especially true for the Shii Station and Kawaraguchi Station, with the ratio of 31% and 28% respectively. Besides, the ratio of Katano Station and Tokuriki Kodanmae Station will be reached 27% (Figure 7).

3.3. Population Density of the Areas along the Monorail

According to the speculations, the situation of population density [11]–[13] in 2025 is shown as follows. The population density at Kokura Station, Heiwadōri Station and Keibajomae Station will decline. Therein, the population density at Kokura Station will reduce from 25 people/ha in 1995 to 15 people/ha in 2025, the population density at Keibajomae Station will reduce from 24 people/ha in 1995 to 18 people/ha, and at Heiwadōri Station from 30 people/ha in 1995 to 24 people/ha. The population will be in a very low density. In addition, in 2025, the stations with the population density of more than 80 people/ha will be Kwaraguchi Station, Katano Station, Moritsune Station, Tokuriki Kodanmae Station, Tokuriki Arashiyamaguchi Station, Shii Station and Kikugaoka Station. Especially at Kikugaoka Station, its population density will reach 149 people/ha in 2025 (Figure 8).

3.4. Numbers of Wholesale Stores in the Areas along the Monorail

Figure 9 shows the number of wholesale stores in the areas along the monorail. As the business centre of Kitakyushu, Kokura has the most wholesale stores. Near Kokura, at Heiwadōri Station, Tanga Station, and Kwaraguchi Station, there are also a lot of such stores. At Kikugaoka Station, the number of wholesale stores is the least. Since there are not many residents at Keibajomae Station, the number of wholesale stores is also small.

3.5. The Annual Sales and the Sales per Unit Area of Stores in the Areas along the Monorail

Figure 10 shows the annual sales and the sales per unit area of stores in the areas along the monorail. In terms of the annual sales, Kokura Station ranks the first, followed by its nearby station, Heiwadōri Station. In terms of the sales per unit area, Heiwadōri Station ranks the top, of 4,568,250,000 yen per ha.

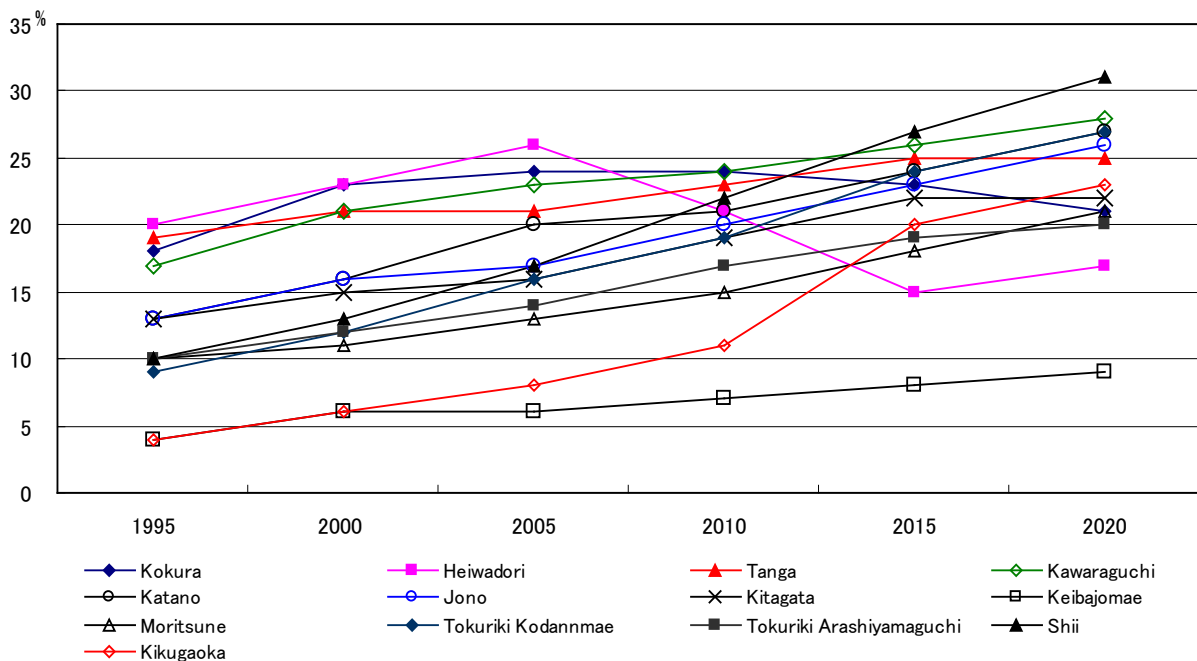


Figure 7. Changes of the aging ratios in the areas along the monorail.

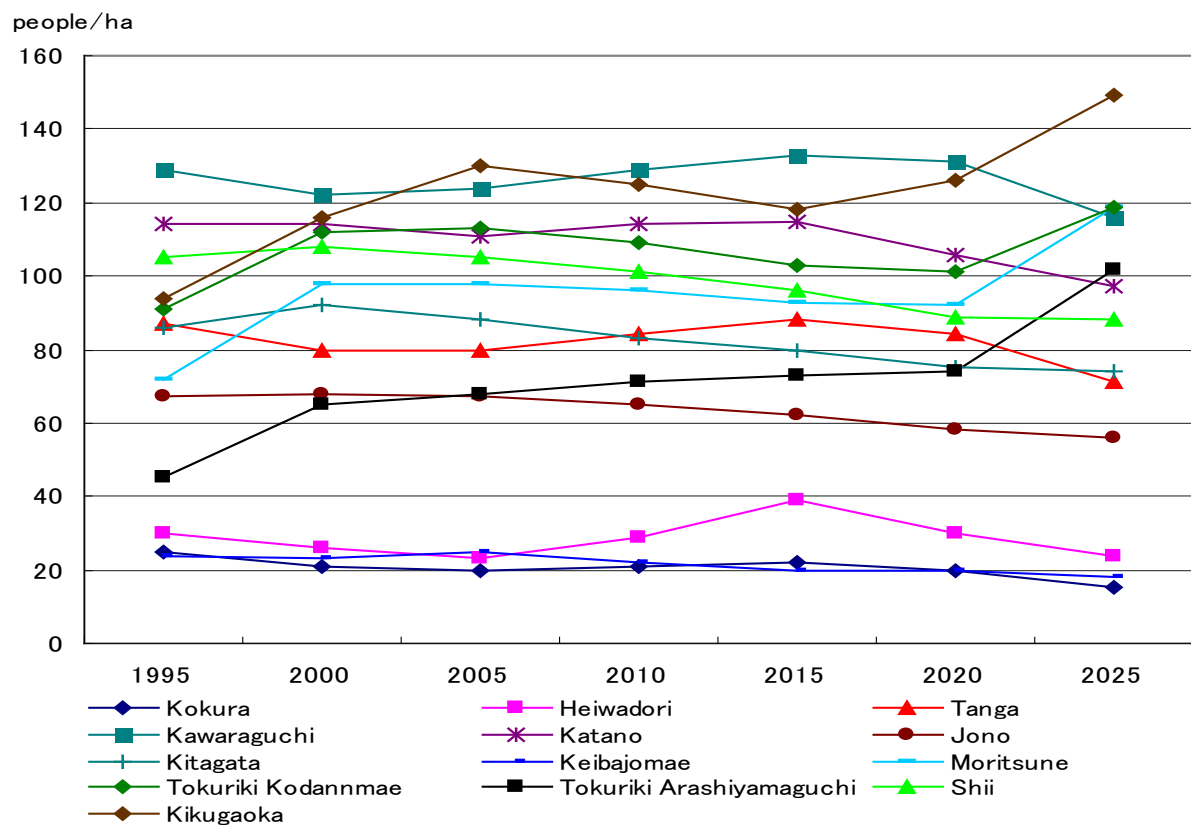


Figure 8. Population density of the areas along the monorail.

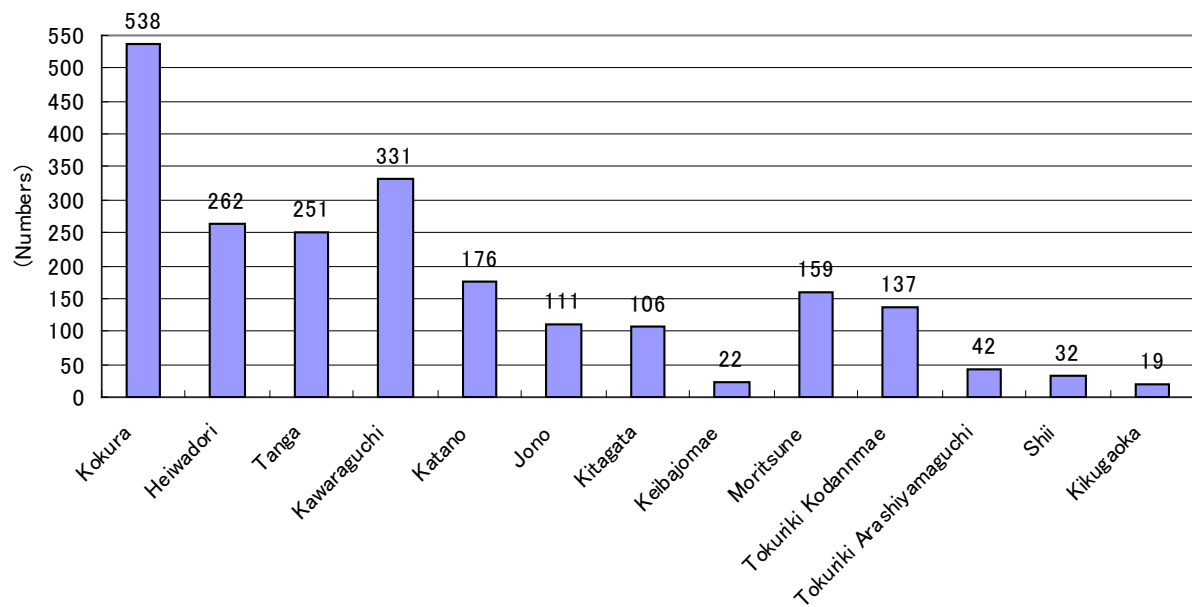


Figure 9. Numbers of wholesale stores in the areas along the monorail.

4. Investigation on the Residents along the Monorail in Kitakyushu and the Analysis of the Questionnaire Results

In order to know the utilizing situation of the monorail by the residents in the surrounding areas and their will of

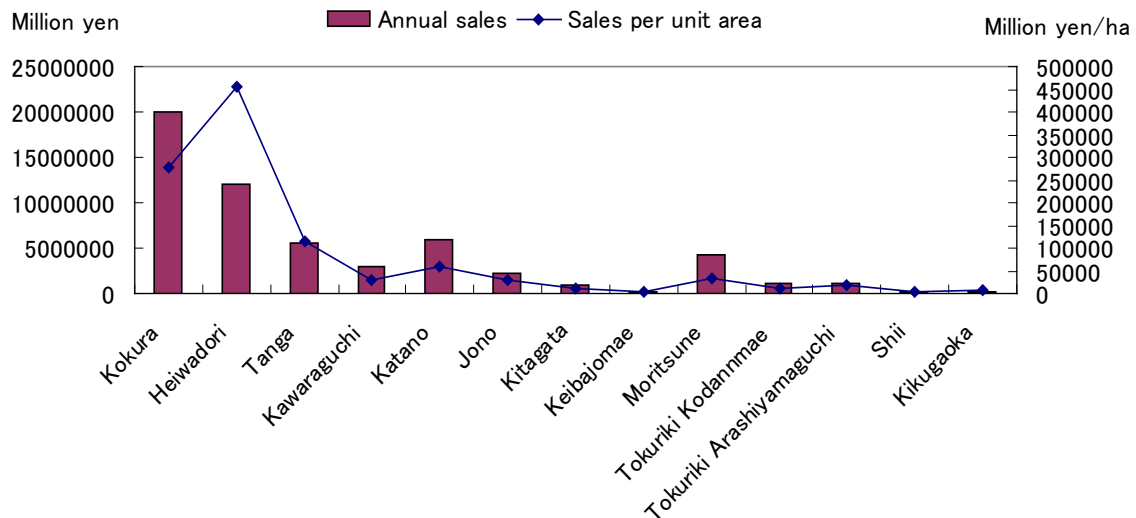


Figure 10. The annual sales and the sales per unit area of stores in the areas along the monorail.

future utilization of the monorail, questionnaire researches were made in 2002 and 2010 to collect the basic data for enlarging the need of the residents along the monorail.

Table 1 is the summary of the research. Subjects of the questionnaire were the males and females aged more than 15 in 2002. In 2010, the subjects were all the users of the monorail. Approaches of delivering the questionnaire, in 2002, it was delivered to the families of residents along the monorail and collected back two weeks later. In 2010, the questionnaires were delivered in each station and collected back at the next station. Collection results: 2867 questionnaires were collected back in 2002 and 6850 questionnaires were collected back in 2010.

4.1. Comparison of the Purpose of the Users of the Monorail

In terms of users' purpose, "commute" accounted for 38.1% in 2010, which was more than twice of 16.3% in 2002. The ratio of "school commutes" in 2010 increased by 10% compared with that in 2002 (6.6% in 2002 and 16.6% in 2010). With regard to shopping as the objective, the ratio in 2010 declined dramatically to 15.1% compared with 37.4% in 2002. The number of private car users increases and people do not have time limitation for using private cars. Therefore the ratio of shopping is in decline. The ratios of "entertainment" and "others" in 2010 reduced by half compared with that in 2002. Besides, the ratios of "business" and "going to the hospital" had no obvious change (**Figure 11**).

4.2. Comparison of the Transportation from Home to Monorail Station

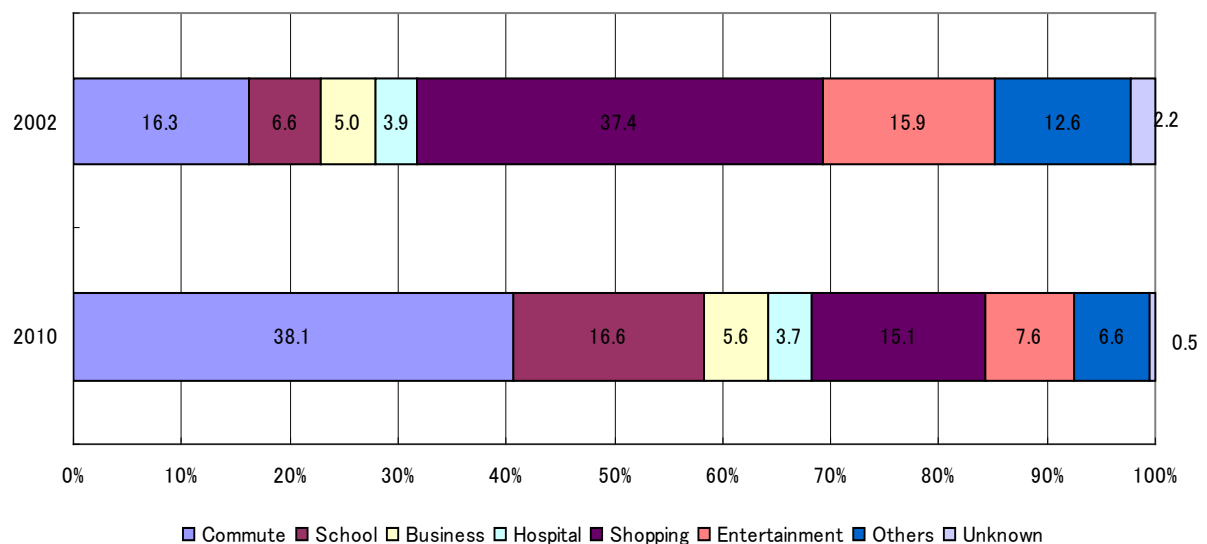
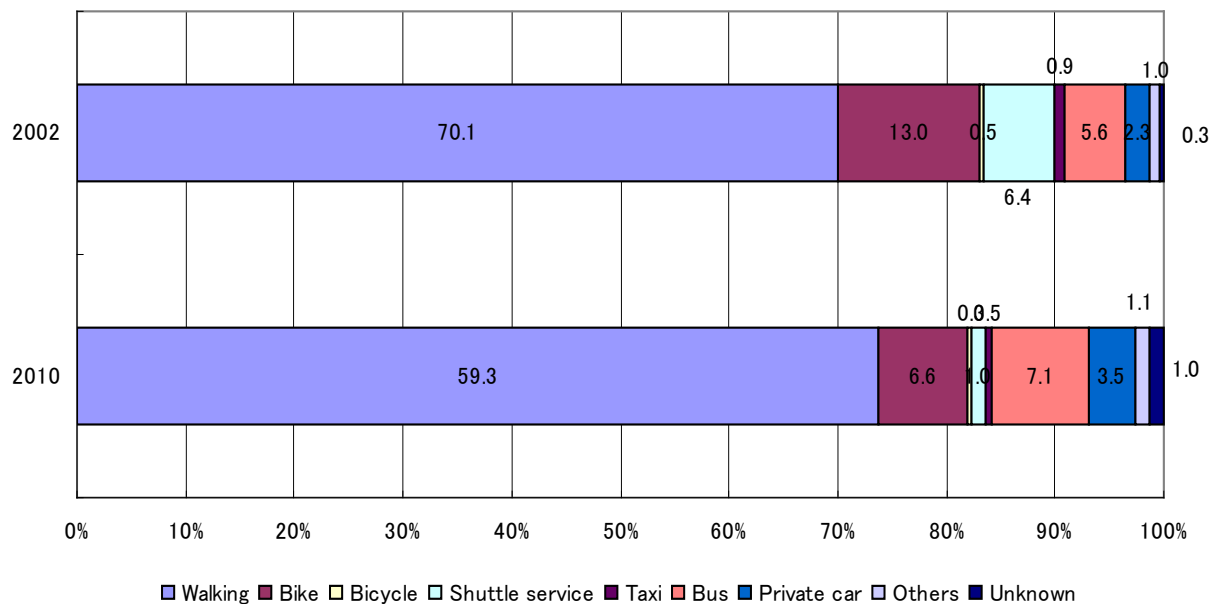
In terms of vehicles taken to the monorail station, "Walking" accounted for 70.1% in 2002 and 59.3% in 2010, with a decrease of about 10%. The ratio of using bicycles in 2010 was almost half of that in 2002 (13% in 2002 and 6.6% in 2010). The ratio of "Shuttle service" was near 6.4% in 2002 and 1% in 2010, which showed a dramatic decrease compared with that in 2002. The ratio of "Private car" increased from 2.3% in 2002 to 3.5% in 2010, with a growth of 1.2%. The ratios of "Bus", "Bicycle" and "Taxi" had almost no change (**Figure 12**).

4.3. Comparison of the Age Groups of Monorail Users

In terms of the age groups of monorail users, the ratio of users aged less than 19 accounted for 6.4% in 2002 and 13.6% in 2010. The ratios of users aged 20, 30, 40 and 50 had almost no obvious change. The ratio of users aged 60 decreased by 3.3% compared with that in 2002. The ratio of users aged more than 70 decreased by 5.2%. When the ratio of users aged 60 is combined with that of users aged more than 70, the total decrease is 8.5%. The increase of private cars led to the result that the ratio of users aged 20, 30, 40 and 50 decreased by 5.6%. When people are more than 65 years old, it will be difficult for them to go out by themselves and the using frequency of public transport in the future will be decreased accordingly. Therefore the shuttle service should be improved to benefit them (**Figure 13**).

Table 1. The summary of the research.

	2002	2010
Subjects	Males and females aged more than 15	All the users
Period	2002/02/02~19	2010/05/20 (From AM8 to PM7)
Method	Visit placement	Distributes on the day and collects
Collection results	2867	6850

**Figure 11.** The purpose of the users of the monorail.**Figure 12.** The transportation from home to monorail station.

5. Discussion

5.1. Analysis and Forecast of the Population in the Areas along the Monorail

According to the analysis and speculations of the population in the areas along the monorail, in 2020, the sta-

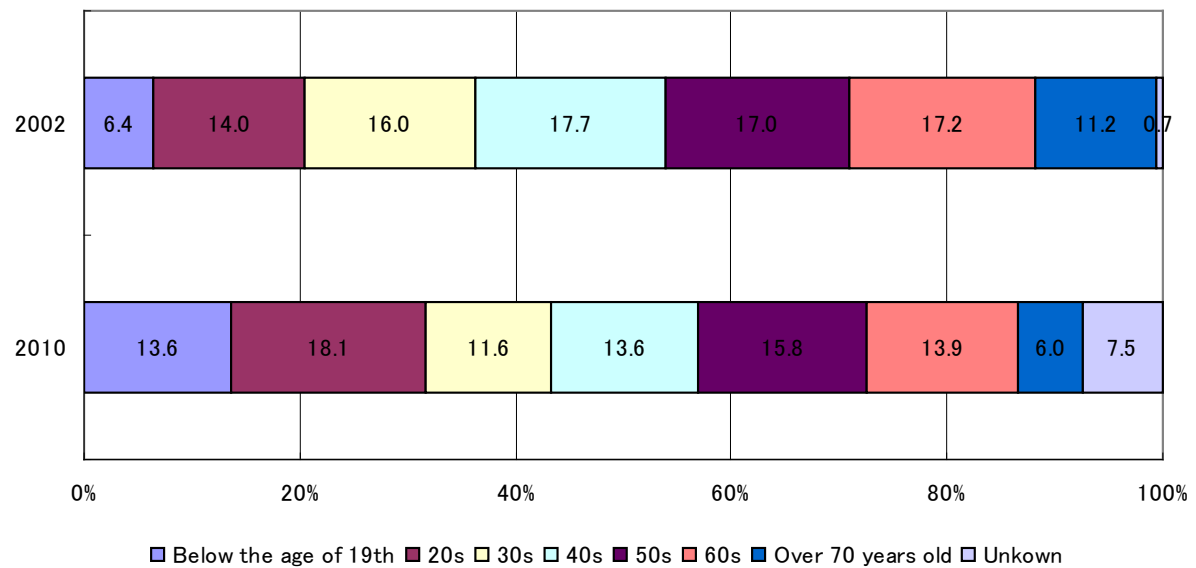


Figure 13. The age groups of monorail users.

tions with the aging ratio of 25% will be Tanga Station, Kawaraguchi Station, Katano Station, Jōno Station, Tokuriki Kodanmae Station and Shii Station. The stations with the reducing population will be Katano Station, Kitagata Station, Keibajomae Station, Moritsune Station, Tokuriki Kodanmae Station and Shii Station. The stations with the aging ratio of more than 25% and the reducing population will be Katano Station, Tokuriki Kodanmae Station and Shii Station. The areas surrounding these stations will enter hyper-aged from nowadays aging society.

5.2. Investigation and Analysis of the Current Use of the Monorail

The research questionnaire showed that the ratio of the monorail users for shopping almost decreased by half, which may be related to the increase of private cars.

In terms of the annual sales of each station, the stations with the most annual sales are Heiwadōri Station, Tanga Station and Katano Station, which are near the Kokura business circle. Shii Station, which is the farthest from the business center, has the least year sales among the total 13 stations. The population reduction will also have influence on the sales of stores surrounding the stations in future.

With regard to the ratios of vehicles taken to the monorail, the ratio of people walking and taking buses and private cars altogether has increased by 11.5%; instead, the ratio of people taking bicycles and shuttle has decreased by 11.8% totally. With the increase of people walking and taking buses, it should be considered to make urban planning and infrastructure construction of public transport [14]–[16] based on the condition of going out on foot.

The ratio of people aged more than 60 in the areas along the line is in decline, while the ratio of the monorail users aged more than 60 has decreased. Since the population has increased, it is necessary to improve the surrounding environment of the aged people, for instance, to offer shuttle service to the monorail station.

6. Conclusions

This study takes the Kitakyushu monorail as the subject. It did research on the current population in the areas surrounding the monorail and made the forecast of their future population. Questionnaires were delivered to investigate the utilization situation of the monorail. The results show that in 2020, the stations with the aging ratio of more than 25% will be Tanga Station, Kawaraguchi Station, Katano Station, Jōno Station, Tokuriki Kodanmae Station and Shii Station. The areas surrounding those stations will enter a super aging society from an aging society. Besides, with the increase of the aging population, thus the number of people who can not take private cars will increase.

Especially for Katano Station, Tokuriki Kodanmae Station and Shii Station, where population decrease and the aging problem have been worsening, their surrounding environment should be further improved. In addition, it should be taken into consideration to increase the population in the walking distance around the stations.

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