ANALYSES OF RELATIONSHIP BETWEEN GROUP COMMUTING AND TRAFFIC ACCIDENTS AMONG ELEMENTARY SCHOOL CHILDREN

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1. Introduction

In Japan, it is very common for elementary school children to walk to and from school. As an effort to secure safety, many elementary schools implement group commuting. In 2018, there are 62.9% of elementary schools in Japan regularly carried out group commuting[1]. However, as the consequence of the traffic accidents involving school children who were walking in a group and caused serious injuries, there may be concerns and arguments that group commuting might risk the children safety while commuting. The objective of this study is to conduct macroscopic analyses of the effect of group commuting on the frequency of traffic accidents among elementary school children during walking to and from school focusing on prefecture-level and city-level.

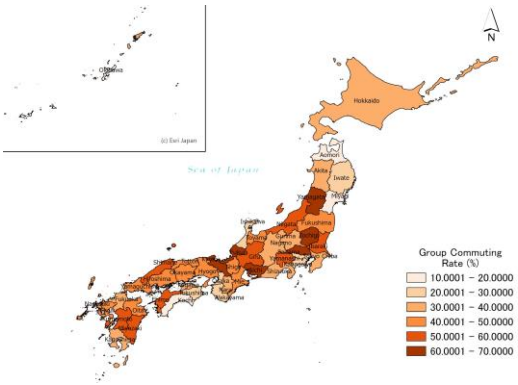

Figure 1 Group commuting rate by prefectures

2. Methodologies

2.1 Prefecture-level Analysis

Prefecture-level analysis mainly used three kinds of data: 1) the total number of children in elementary schools in the years 2016-2020 by prefectures, from the national school survey, 2) the rate of schools that implement group commuting (group commuting rate) as shown in **Figure 1**, from survey for promoting school safety[1], and 3) the number of elementary school children who sustained road traffic injuries (RTI) while walking and cycling in the years 2016-2020, from ITARDA Traffic aggregation tool[2]. To identify the effect of group commuting rate on RTI, the RTI rate [RTI/year] was calculated as the number of RTI divided by the number of children, for each prefecture. Then, to consider the non-linear relationship between the number of children, the group commuting rate, and the number of RTI, a negative binomial regression model (NBM) analysis was conducted using trip purpose dummy variables and time zone dummy variables.

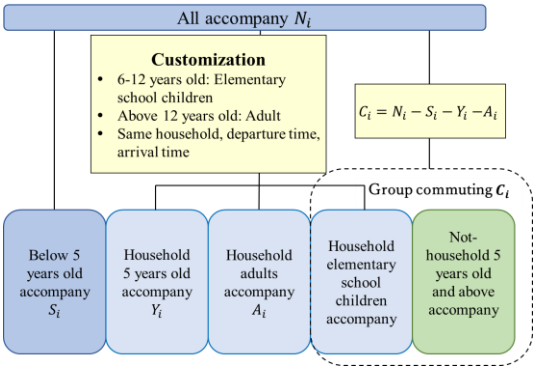

Figure 2 Flow to find the accompany for group commuting

2.2 City-level Analysis

City-level analysis focused on elementary school children in Aichi prefecture and mainly used two data: 1) the person-trip data, from 5th Chukyo Urban Area Person Trip Survey, and 2) the accident data involving elementary school children while walking in the years 2009-2018, provided by Aichi Prefectural Police. Since there was no available data on group commuting rate as in prefecture-level analyses, the number of group commuting accompany was calculated as the flow shown in **Figure 2**. A group commuting trip in this analysis was defined as a trip by an elementary school child that was commuting with accompanies which consisted of household elementary school children and not household 5 years old and above people. Next, the histogram of frequency of the trips by accompany number for elementary school children was created to determine the accompany number that can be considered as group commuting (**Figure 3**). It was decided that three people and above as the number of accompany that can be determined as a group commuting trip according to the histogram. After having the data of group commuting trips, the group commuting rates and the traffic accidents rates were calculated for each city in Aichi prefecture. Here, traffic accident rate [accidents/trip or trip time] was calculated as the number of traffic accidents divided by the number of trips or total trip time. To identify the relationship between the group commuting rate and the traffic accidents rate, scatter plots are created followed by the NBM analysis with consideration of trip number and total trip time.

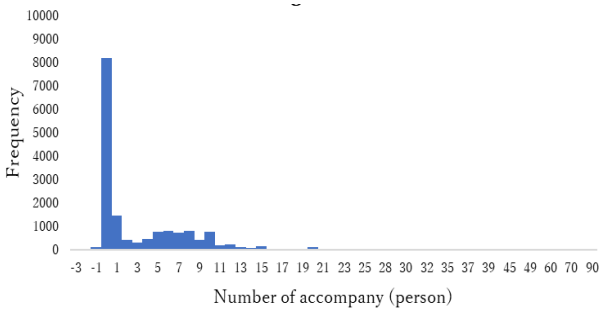

Figure 3 Frequency of trips by accompany number

3. Results and Discussions

3.1 Prefecture-level Analysis

Figure 4 indicates that the higher the group commuting rate, the lower the RTI rate. Prefecture-level NBM analysis **(Table 1)** described that the number of children and the number of RTI has an almost linear relationship for commuting purpose while the number of RTI increases rapidly as the number of children increases for non-commuting purpose. It could be considered that the

higher number of children means more urbanized prefectures, and thus there are a lot of accessible places on children's feet. Therefore, this tends to a higher frequency of children who walk or cycle for non-commuting purpose, which consequently increases the number of traffic accidents involving elementary school children. The NBM result also described that commuting purpose has a significant relationship that the higher the rate of group commuting, the lower the number of RTI. Analysis model using time zone dummy **(Table 2)** shows that the higher the rate of group commuting, the lower the number of RTI for each time zone, particularly it decreases gradually on 6-9 am (time to school) compared to return time and other times zones. This is probably because the time schools end is different depending on grades. Hence, it is considered that group commuting during walking home from school does not be implemented among most elementary school children.

3.2 City-level Analysis

The scatter plots between group commuting rate and traffic accident rate show almost the same result in both considerations of trip number and total trip time that described the higher the group commuting rate, the lower the traffic accident rate. However, the consideration of total trip time has expectedly given more significant results (R^2=0.1129) with lower AIC (**Figure 5, Table 3**). The NBM analysis showed that both considerations have a significant effect on the number of traffic accidents with almost linear relationships during both walking to and from school. These described that the more the number of trips as well as the total time of trips, the higher the risk of elementary school children to encounter traffic accidents. Moreover, both consideration of trip number and total trip time showed that group commuting does significantly affect the number of traffic accidents during walking to school as the higher the rate of group commuting, the lower the number of traffic accidents. Overall, the statistical analysis results described that city-level analysis provided clear results on the effect of group commuting on the number of traffic accidents among elementary school children.

4. Conclusion

Prefectures and cities with a higher rate of group commuting show a lower number of children who sustained RTI and the number of traffic accidents, respectively. So, it could be suggested that group commuting has a certain traffic safety effect among elementary school children for commuting. However, regarding the survey on the status of effort related to plans for promoting school safety, the data of group commuting rate used in this study that also included other than elementary schools may affect the prefecture-level analysis results. Using person-trip data in city-level analysis to find the rate of group commuting has also become a limitation in this study as it was still unknown whether the data certainly match each school policy of group commuting. Further study should separate the group commuting analysis among elementary school children by grades and it is better to have specific data on group commuting from cities as well for better results.

REFERENCE

1) Ministry of Education, Culture, Sports, Science and Technology, Japan, 2018. Survey on the status of effort for promoting school safety.
2) Traffic Accident Aggregation Tool, Institute of Traffic Accident Research and Data Analysis (ITARDA).

ACKNOWLEDGEMENT

This work was supported by JSPS KAKENHI Grant Number 20K04743.

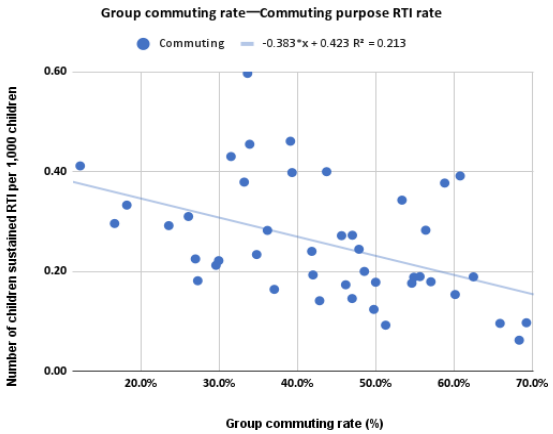

Figure 4 RTI rate and group commuting rate (Prefecture-level)

Table 1 Estimated results of NBM by trip purpose (Prefecture-level)

Independent variable	Coefficient	P>|z|
_cons	-8.11	0
non_comm_dummy	-3.21	0.024
lnChild_num * Comm_dummy	1.03	0
lnChild_num * Non_comm_dummy	1.33	0
Grp_comm_rate * Comm_dummy	-0.0145	0.001
Grp_comm_rate * Non_comm_dummy	-0.0031	0.442

Table 2 Estimated results of NBM by time zone (Prefecture-level)

Independent variable	Coefficient	P>|z|
_cons	-8.78	0.00
Ret_time_dummy	0.23	0.88
Oth_time_dummy	-4.10	0.02
lnChild_num * Sch_time_dummy	1.02	0.00
lnChild_num * Ret_time_dummy	1.02	0.00
lnChild_num * Oth_time_dummy	1.17	0.00
Grp_comm_rate * Sch_time_dummy	-0.0185	0.0000
Grp_comm_rate * Ret_time_dummy	-0.0125	0.0040
Grp_comm_rate * Oth_time_dummy	-0.0131	0.0290

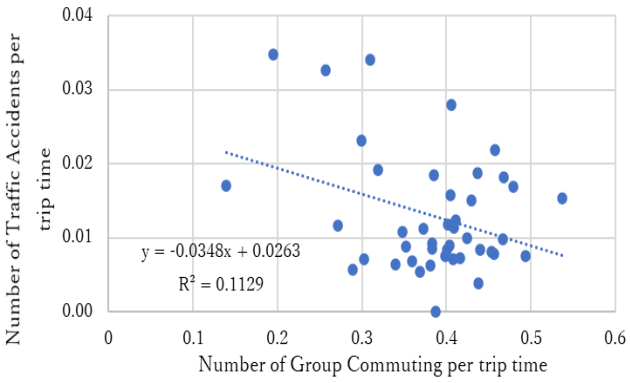

Figure 5 Accident rate and group commuting rate (City-level)

Table 3 Estimated results of NBM by trip time (City-level)

Independent variable	Coefficient	P>|z|
_cons	-10.35	0
lnTrip_time	1.05	0
Grp_comm_rate	-0.0222	0.044