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Drivers' perceptions regarding speeding and driving on urban residential streets with a 30 km/h speed limit



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ABSTRACT

Previous studies have shown very little information regarding drivers' opinions, attitudes and behaviours with respect to speeding and driving on urban residential streets with a 30 km/h speed limit. The present research aims to address this issue by conducting a questionnaire study with a sample of 367 Japanese drivers. The results showed that drivers tended to have positive beliefs about complying with the 30 km/h speed limit and understand the negative consequences of speeding; however, a majority of the drivers considered breaking the speed limit as a way to reduce their travel time. While the extent of speeding was found to be very serious, a number of drivers still supported the use of a 30 km/h speed limit on residential streets and favoured protecting the right of vulnerable street users. The logistic regression models developed in this study identified that the drivers who did not support the 30 km/h speed limit were associated with those who had committed traffic-law violations, who had negative beliefs about complying with the speed limit, who did not consider residents' opinions, who believed it is acceptable for them to drive at a high speed, and who felt it difficult to refrain from speeding. With regard to anti-speeding countermeasures, under drivers' point of view, streets should be designed to make the 30 km/h speed limit more credible, although this study also showed evidence supporting the application of public awareness programmes and social campaigns as speeding interventions. In addition, this research investigated drivers' speed choices in various specific driving circumstances, and six underlying factors affecting drivers' speed choices were determined. On the basis of the findings, the implications and suggestions for speeding interventions were also discussed.

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1. Introduction

A speed limit of 30 km/h has been introduced in many countries such as Japan to ensure traffic safety and allow urban residential streets to fulfil other intended functions. Abundant evidence in previous studies has demonstrated the safety benefits to be gained from the application of this speed limit. For example, OECD/ECMT in 2006 [1] reported that 90% of pedestrians hit by a car travelling at 30 km/h survived; whereas only 20% of pedestrians hit by a car travelling at 50 km/h survived. Similarly, in a study by Rosén and Sander in 2009 [2], the pedestrian fatality risk at 50 km/h was more than twice as high as the risk at 40 km/h and more than five times the risk at 30 km/h. Other studies found significant reductions in accident

frequency and severity on neighbourhood streets after 30 km/h speed limits were implemented [3,4].

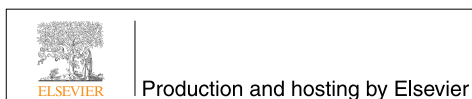
Despite the many benefits, the application of the 30 km/h speed limit on urban residential streets is unlikely to be well understood by all drivers. In fact, excessive speeds on these roads are very common. OECD/ECMT in 2006 [1] reported that 77% of drivers in Austria exceeded the 30 km/h speed limit compared to 51% speeding on 50 km/h urban streets and 18% speeding on 100 km/h roads. Similarly, a survey in Japan showed that only a few people drove at or below the 30 km/h speed limit and nearly half of the speed-recorded vehicles ran at speeds of 40 km/h or more on streets with a 30 km/h speed limit [5].

Drivers seem to not find it easy to drive at low speeds. In a survey by Stradling et al. in 2003 [6], most drivers agreed that it is difficult to manoeuvre modern cars at speeds below 56 km/h (35 mph). It is also conceivable that driving on residential streets with a 30 km/h speed limit differs in some circumstances from driving on streets with higher speed limits. In addition to the primary function of providing access to adjacent buildings and land-lots for all street users, many residents' daily-life activities occur on these residential streets, unlike other urban streets. In Japan, pedestrians and cyclists often have to share the roadways of these residential streets with motorised vehicles, putting them at high risks for accidents. In these situations,

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drivers are forced to give priority to vulnerable street users anywhere they are encountered. Given such special driving conditions, differences between drivers' perceptions regarding speeding and driving on residential streets with a 30 km/h speed limit and those on other types of streets are expected.

To cope with speeding issues in urban neighbourhoods as well as making the 30 km/h speed limit more credible to drivers, it is necessary to discover drivers' perceptions regarding speeding and driving on urban residential streets with a 30 km/h speed limit. To date, a number of studies have been conducted to explore drivers' opinions, attitudes, and behaviours with respect to speeding and driving-related matters. However, all previous studies targeted driving on general roads or general urban streets; there has been very little information published specifically about speeding and driving on 30 km/h residential streets. This lack of this knowledge is an obstacle in forming effective policies for introducing this speed limit as a means for dealing with local traffic safety issues.

2. Literature review

Previous research suggested that not all drivers were able to correctly recognise the speed limit of a given road, which may have therefore led to unintentional speeding. Stradling et al. in 2003 [6] showed that the rate of Scottish drivers who could exactly state the speed limit of a given road from photographs ranged from 49% to 88% because of different driving situations. In another study by Lahausse et al. in 2010 [7], only 8% of the respondents correctly identified the current speed limits on all of the four study roads from pictures of the roads. From this finding, the researchers suggested that the public's knowledge about speed limits and their purposes could be improved to gain more desirable driving behaviours.

A number of previous studies showed that drivers often speed across entire road network. For example, OECD/ECMT in 2006 [1] reported that more than half of European drivers exceeded the posted speed limit, although the extent of speeding varied with country and road type. A survey in USA similarly indicated that only approximately 5% of drivers travelled at the 88 km/h (55 mph) speed limit on interstate highway segments and that 23% of drivers travelled at or below the posted speed limit on non-freeway roads [8].

There was evidence that drivers tended to overestimate the speed of other drivers. Walton and Bathhurst in 1998 [9] found that more than 85% of drivers claimed their driving speed was lower than that of other drivers on average. In a study by Åberg et al. in 1997 [10], respondents stated that more than 50% of other people drove faster than 60 km/h on 50 km/h roads while the corresponding observed figures ranged between 16% and 25%. In that same study, drivers on average estimated the other drivers' speeds to be 8–10 km/h higher than their actual speeds. As noted by Haglund and Åberg in 2000 [11], because the perceived behaviour of others significantly influenced an individual's speeding behaviour, inaccurate estimation about others' speeds likely contributed to an individual's own speeding violations.

Previous research has shown evidence about the effect of social norms regarding vulnerable road users on drivers' speed choices. As illustrated by Wallén Warner and Åberg in 2008 [12], social pressure from “people along the streets (i.e., pedestrians, cyclists, and residents)” was the only significant predictor of both a direct measure of a subjective norm and intention to exceed the speed limit in an urban street environment.

Prior studies have made efforts to discover drivers' speeding motivations. In a study by EKOS Research Associates in 2005 [13], the most important reason used by drivers to justify their excessive speeds was “do not want to be late” (stated by 57% of respondents), followed by beliefs that “speed limits are set too low” (51%) and “they are not paying attention to (the) speed at which they are driving” (51%). Although only 20% of drivers considered “enjoying the feeling of driving fast” as a reason for speeding, both the qualitative results

and the regression analysis in the same study indicated that this factor was linked to the more extreme instances of speeding. Another study by Kanellaidis et al. in 1995 [14] found that “do not consider the speed limit signs as reliable” was the primary reason for speeding violations. The study also showed that, in general, drivers who believed that complying with speed limits could reduce accidents were much more likely to observe speed regulations.

Drivers' speeding has been studied by a number of researchers by using the framework of the Theory of Planned Behaviour. For example, Wallén Warner and Åberg in 2008 [12] found that the intention to exceed the speed limits in both urban and rural environments can be predicted with reasonable accuracy by drivers' attitudes, subjective norms, and perceived behavioural control.

The negative consequences of speeding have been perceived by some drivers. The survey by EKOS Research Associates in 2005 [13] found that 54% of respondents indicated a higher collision risk as a disadvantage of speeding, while 35% identified a risk of a ticket, and 31% indicated a high risk of injury from a collision.

Stradling in 2007 [15] suggested that drivers' speed choices resulted from the interactions of opportunities, obligations and inclinations. In that study, drivers were asked to indicate whether they would drive slower, the same, or faster than their normal speeds in various driving situations. The results from a principle component analysis identified three underlying factors affecting drivers' speed choices, namely adverse driving conditions, responsibilities to others, and arousal. In a study by Gabany et al. in 1997 [16], a perceptual inventory was developed to examine the factors that predispose, enable, and reinforce drivers' speeding behaviours. As a result, five predisposing, enabling and reinforcing constructs were identified to represent drivers' perceptions and attitudes toward speeding, including ego gratification; risk-taking; time pressures; disdain of driving; and inattention.

There have also been studies that looked at drivers' perceptions about speeding countermeasures. In a study by Stradling et al. in 2003 [6], most drivers stated that physical barriers were effective at making them reduce their speeds. In addition, other measures such as electronic road signs indicating speeding behaviour (e.g., automatic speed cameras), increased police enforcement, in-vehicle driver information systems, black box collision reporting of speeding, and publicity and information campaigns were also considered by drivers to be good ideas for addressing speeding issues [9]. Other studies [17,18] demonstrated significant reductions in average speeds and the number of drivers exceeding the speed limit after the introduction of an increased level of traffic-law enforcement.

Although speeding is very common, many drivers seem to agree with the current speed limits. A survey by NHTSA in 2003 [19] showed that, while approximately 75% of drivers in America admitted to speeding on all road types, the existing speed limits were still considered to be appropriate by most people, ranging from 61% for multi-lane interstate highways to 83% for city, town and neighbourhood roads. Similarly, 87% of respondents in a study conducted by the Ministry of Transport in 2007 [20] in New Zealand said that the speed limits on the roads they normally drove on were about right. In the study, only 8% of people favoured raising the speed limit for 50 km/h urban roads, while the corresponding figure for rural roads with a 100 km/h speed limit was 17%. However, support for lowering speed limits is often lower than support for current speed limits, depending on the specific context. Lahausse et al. in 2010 [7] found that, while a significant number of drivers favoured proposed lower speed limits on 100 km/h two-lane undivided rural roads and rural gravel roads, speed limit reductions in urban areas were only supported by approximately one-third of surveyed drivers. Only 3% of respondents in a study by the Australian Transport Safety Bureau in 2005 [21] were in favour of reduced speed limits because they thought that the current 50 km/h speed limit on residential streets was too high.

Several demographic and driving factors have been found to influence speeding behaviour. The groups of people who are most likely

to speed were identified in previous studies as males, young drivers (under 30 years of age), less-experienced drivers (had their licence for 10 or fewer years), and people who travel a high number of kilometres (in excess of 20,000 per year) [13,21–25]. Involvement in traffic accidents was also found to be associated with speeding [6,26,27].

3. Research objectives

To the best of our knowledge, no previous studies specifically focused on drivers' perceptions regarding speeding and driving on urban residential streets with a 30 km/h speed limit have been published. This study therefore was designed to fill this gap. The goals were met by (i) exploring drivers' knowledge, opinions and attitudes towards speeding on 30 km/h residential streets and the current 30 km/h speed limit, and (ii) identifying factors that influence drivers' speed choices while driving on these roads.

4. Method

4.1. Instrument

A questionnaire was developed for the specific purposes of the present research. All items included in the questionnaire could be placed in one of several groups, with each targeted to examine different aspects of speeding and driving on urban residential streets with a 30 km/h speed limit. Drivers were asked about (i) their general knowledge and opinions about residential streets with a 30 km/h speed limit, (ii) their self-reported speeding behaviour, (iii) their perceptions regarding the speeding opinions and behaviours of others, (iv) their attitudes towards exceeding and observing a 30 km/h speed limit, (v) their attitudes towards the current 30 km/h speed limit, and (vi) factors that influence their speed choices while driving on 30 km/h residential streets. Several demographic variables were also measured including age, gender, driving frequency, whether the respondent had been involved in an accident during the last 3 years, and whether the respondent had been stopped by police during the last 3 years. A mixture of multiple choice and 5-point Likert-scale items was used in the questionnaire.

4.2. Participants

A questionnaire survey was administered in the City of Saitama, Saitama Prefecture, Japan between August 28th and November, 30th 2011. Questionnaires were randomly distributed to vehicle drivers who stopped at signalised intersections on two selected residential street sections that had 30 km/h speed limits. Participants were

asked to fill in the questionnaire and return it by a provided pre-paid envelope within 4 weeks. Of 1145 distributed questionnaires, 374 questionnaires were returned, accounting for 32.7% of all distributed surveys. After a preliminary examination of the surveys, 367 complete questionnaires (32.1%) were used for further analysis. Descriptive statistics of the demographic and driving variables are shown in Table 1. Notably, of those who participated in this study, nearly 40% were female; 63.5% drove daily; 37.6% had been either involved in a real or near-miss accident, and 24.5% had been stopped by police during the last 3 years. It should be noted that the sample has a driver's gender distribution quite similar to that of a licenced driver population in Saitama Prefecture which consisted of 42.0% females and 58.0% males for the year 2009 [28]. With regard to age distribution, a similar pattern can be seen in middle-age groups (60.5% drivers aged 30–60 for this study compared to 65.0% for Saitama Prefecture [28]). However, admittedly the study sample suffers from an under-representation of young drivers because only 3% of drivers aged under 30 participated in this study compared to 16.0% for the Saitama Prefecture. There is also difference regarding the group aged over 60 (31.9% for this study compared to 23.5% for the Saitama Prefecture).

5. Results

5.1. General knowledge and opinions about 30 km/h residential streets

Six questions were used to explore drivers' general knowledge and opinions about residential streets with a 30 km/h speed limit. Respondents were asked to state their opinions about the perceived functions of 30 km/h residential streets, the perceived rights of vulnerable street users, the perceived seriousness of speeding in residential neighbourhoods, the most effective anti-speeding countermeasures, and the perceived easiness of observing the 30 km/h speed limit on a given driving street. The perceived rights of vulnerable street users were revealed by the question: "To what extent do you agree that drivers should give priority to pedestrians/cyclists anywhere they are encountered on 30 km/h residential streets?" The possible answer options for each item and the descriptive statistics of these variables are shown in Table 2.

The results shown in Table 2 indicated that more than half of the drivers (59%) believed that, for residential streets with a 30 km/h speed limit both the function of maintaining traffic and the function of serving other residential needs (serving as living spaces) are equally important. Those who felt that one function was more important than the other were about the same, as a total of 19% favoured maintaining traffic and 22% said that serving other residential needs was the main function or the more important function.

With respect to the perceived rights of vulnerable street users, the low mean score of 1.98 for this variable (see Table 2) indicated that drivers tended to voluntarily respect that right. In addition, the results showed that only 7% of drivers disagreed while 70% of them agreed to at least some extent that drivers should give priority to pedestrians/cyclists anywhere they are encountered on 30 km/h residential streets.

Drivers tended to consider speeding to be a serious issue in neighbourhoods as indicated by the high mean score of 3.58 for item 3 in Table 2. The survey revealed that the majority of respondents (68.6%) claimed that speeding was a serious or very serious matter in residential areas.

Amongst several provided anti-speeding countermeasures, less than 10% of drivers selected "reinforcing police patrols or increasing traffic-law-breaking fines" as the most effective way to solve speeding problems. A moderate portion of respondents (22.9%) relied on warning people and raising their awareness about the bad consequences of speeding, while more than 60% believed that either redesigning streets to make them inherently calmer or installing traffic calming tools as the most effective interventions.

Table 1
Descriptive statistics of demographic and driving variables.

Attribute	Categories	Frequency	Percent (%)
1. Gender	Male	227	61.9
	Female	140	38.1
2. Age	<30	11	3.0
	30s	71	19.3
	40s	97	26.4
	50s	71	19.3
	>60	117	31.9
3. Driving frequency	Almost everyday	233	63.5
	Approximately 2–3 times per week	121	33.0
	About once a week	11	3.0
	Less than once a week	2	0.5
4. Real/near-miss accident involvement during the last 3 years	Yes	138	37.6
	No	229	62.4
5. Police-stopped incident during the last 3 years	Yes	90	24.5
	No	277	75.5

Table 2
General knowledge and opinions about 30 km/h residential streets.

Items	Possible values	Percent (%)	Mean	SD
1. Perceived functions of 30 km/h residential streets	1. Mainly for traffic moving	6.3	3.05	0.89
	2. Traffic moving is more important	13.1		
	3. Both functions are equally important	58.6		
	4. Living space is more important	16.3		
	5. Mainly for living space	5.7		
2. Perceived rights of vulnerable street users	1. Definitely agree to 5. Definitely disagree	–	1.98	1.03
3. Perceived seriousness of speeding	1. Not a serious matter to 5. Very serious matter	–	3.58	1.16
4. The most effective anti-speeding countermeasure	1. Reinforcing police patrols and increasing traffic-law-breaking fines	9.8	–	–
	2. Redesigning residential streets in order to make them inherently calmer	33.5		
	3. Setting up traffic calming measures like speed humps to enforce people to drive slowly	27.0		
	4. Warning people and raising their awareness about the bad consequences of speeding	22.9		
	5. Others	6.8		
5. Perceived easiness of observing the 30 km/h speed limit	1. Easy to 5. Difficult	–	3.09	0.85

Drivers were also asked how easy it is to observe the 30 km/h speed limit on a given driving street section. The result showed that the speed limit is not seen as easy to observe by all drivers because only 24% of respondents gave an answer of either “easy” or “somewhat easy” to this question, while by contrast, a third of them (33.5%) gave an answer of either “difficult” or “somewhat difficult”.

5.2. Drivers' self-reported speeding behaviours

This study revealed drivers' speeding behaviours by asking them to state their frequency of speeding both in the past and in the future, and how difficult it was for them to avoid exceeding the speed limit when driving on 30 km/h residential streets. Table 3 presents the possible answer options for each question and descriptive statistics of the responses.

As expected, the data showed that excessive speeds are very common on residential streets with a 30 km/h speed limit. On average, people exceeded the speed limit on these roads “sometime” or “often” as indicated by the mean score for speeding in the past of 3.38 as showed in Table 3. Only 2% of respondents said that they had never exceeded the speed limit while 57% admitted to breaking the speed limit either “often” or “very often”. Further analysis shown that, on average, women tended to exceed the speed limit less frequently than men. The survey found that women reported “never” or “rarely” exceeding the speed limit more often than men did (34.6% of women compared to 18.4% of men; $\chi^2 = 5.80$, $p = 0.016^*$). A majority of drivers (97.3%) said they would continue to speed to at least some extent in the future although 29.9% of them said that they would break the speed limit less frequently than before. Overall, the frequency of speeding stated by drivers significantly reduced after their involvement in the survey ($\chi^2 = 25.99$, $p = 0.000^{**}$).

Although drivers tended to favour speeding, it is likely that they also had the ability to control this driving violation. More than half of the surveyed drivers (53.7%) said that it was easy or somewhat easy for them to control their speeding if they wanted to. Women seem to be more confident than men regarding the perceived difficulty of not speeding. The data showed that 10% of men compared

Table 3
Drivers' self-reported speeding behaviours.

Items	Possible values	Mean	SD
1. Frequency of speeding in the past	1. Never, 2. Rarely, 3. Sometime 4. Often, 5. Very often	3.38	1.06
2. Frequency of speeding in the future	1. Never, 2. Rarely, 3. Sometime 4. Often, 5. Very often	3.08	1.05
3. How easy/difficult to avoid speeding?	1. Easy to 5. Difficult	2.59	0.86

to 18.9% of women stated that not exceeding the speed limit would be either somewhat difficult or very difficult ($\chi^2 = 5.28$, $p = 0.022^*$).

5.3. Perceptions regarding the speeding opinions and behaviours of others

With respect to perceptions regarding other people's opinions about speeding on residential streets with a 30 km/h speed limit, respondents were asked to what extent “pedestrians/cyclists would appreciate drivers who do not exceed the 30 km/h speed limit” and “residents living along these streets would feel happy if drivers do not exceed the 30 km/h speed limit”. The perception of speeding by others was revealed by the question: “To what extent do you agree that most people in Saitama City usually break the 30 km/h speed limit”. The possible values for all questions ranged from 1. *Definitely agree* to 5. *Definitely disagree*. The descriptive statistics of these results are presented in Table 4.

The results in Table 4 show low mean scores for the first two items. This indicated that drivers tended to be aware of the concerns of vulnerable street users about speeding. The data also showed that more than 60% of respondents agreed while less than 14% of them disagreed to any extent that vulnerable street users or residents would appreciate/feel happy if drivers observe the 30 km/h speed limit. However, drivers tended to claim that other vehicle users exceeded the speed limit, as indicated by the low mean score of 2.15 for item 3 in Table 4. In the survey, 68% of respondents agreed that most people in Saitama usually exceed the 30 km/h speed limit, while only 7% of them disagreed to any extent.

5.4. Attitudes towards exceeding and observing a 30 km/h speed limit

Four questions were used to explore beliefs about exceeding and observing a 30 km/h speed limit. Respondents were asked to state to what extent “complying with the 30 km/h speed limit would decrease the risk of accidents”, “complying with the 30 km/h speed limit would make them uncomfortable”, “breaking the 30 km/h

Table 4
Perceived others' speeding opinions and behaviours.

Items	Possible values	Mean	SD
1. Residents would feel happy if drivers do not exceed the speed limit	1. Definitely agree to 5. Definitely disagree	2.08	1.18
2. Pedestrians/cyclists would appreciate drivers who do not exceed the speed limit	1. Definitely agree to 5. Definitely disagree	2.18	1.24
3. Most people in Saitama City usually break the speed limit	1. Definitely agree to 5. Definitely disagree	2.15	0.98

Table 5
Attitudes towards exceeding and observing a 30 km/h speed limit.

Items	Possible values	Mean	SD
1. Complying with the 30 km/h speed limit would decrease the risk of accident	1. Definitely agree to 5. Definitely disagree	1.62	0.84
2. Complying with the 30 km/h speed limit would make you uncomfortable	1. Definitely agree to 5. Definitely disagree	3.92	1.12
3. Breaking the 30 km/h speed limit would be a high risk of being stopped by police	1. Definitely agree to 5. Definitely disagree	2.37	1.26
4. Breaking the 30 km/h speed limit would save time and enable you to arrive destination faster	1. Definitely agree to 5. Definitely disagree	2.38	1.25
5. How acceptable to drive at 40 km/h on 30 km/h streets?	1. Not acceptable to 5. Acceptable	3.41	1.15
6. Occasionally exceeding the 30 km/h would be socially acceptable	1. Definitely agree to 5. Definitely disagree	2.37	1.18

speed limit would be a high risk of being stopped by police”, and “breaking the 30 km/h speed limit would save time and enable them to arrive at their destination faster”. Two other questions, “How acceptable is it to drive at 40 km/h on 30 km/h residential streets?” and “To what extent do you agree that occasionally exceeding the 30 km/h speed limit would be socially acceptable?” were also used to reveal drivers' attitudes towards speeding. Table 5 illustrates the possible answer options for each question and the descriptive statistics of the results.

Item 1 in Table 5 had a low mean score of 1.62, which indicated that drivers tended to perceive safety benefits from observing the 30 km/h speed limit. In the survey, a majority of respondents (85.5%) either “definitely agree” or “somewhat agree” that complying with the speed limit would decrease the risk of accidents while only 2.7% of them disagreed with the statement to any extent.

The survey results revealed that complying with the 30 km/h speed limit was not perceived as a discomfort because a majority of respondents disagreed that complying with the speed limit would make them uncomfortable, as indicated by the high mean score of 3.92 for item 2 in Table 5. Only 11.7% of the surveyed drivers believed that complying with the speed limit would make them either definitely uncomfortable or somewhat uncomfortable.

With regard to exceeding the 30 km/h speed limit, 62.9% believed that this driving violation would result in a high risk of them being stopped by police. A number of drivers (65.1%) stated that they could reduce their time and arrive at their destination faster by speeding. On average, men agreed with the time-saving benefit from breaking the 30 km/h speed limit more than women did ($\chi^2 = 12.82$, $p = 0.012^*$).

Drivers were likely to accept their own speeding as indicated by the high mean score of 3.41 for item 5 in Table 5. When asked about how acceptable it was to drive at 40 km/h on 30 km/h residential streets, 38% of drivers said it was either “somewhat acceptable” or “acceptable” while only 29% selected either “not acceptable” or “somewhat not acceptable”.

In addition, drivers were similarly unlikely to consider speeding as a socially unacceptable action. A majority of respondents (69%) agreed that occasionally exceeding the 30 km/h speed limit would be socially acceptable, while only 18% disagreed with this statement to any extent.

5.5. Attitudes towards the current 30 km/h speed limit

It is important to know whether the application of the current speed limit of 30 km/h for urban residential streets was supported by vehicle drivers. Respondents were asked how appropriate they found that speed limit to be. The result was that 66% of the respondents stated that the speed limit is either reasonable or somewhat reasonable for most cases. However, 18% did not support the current

30 km/h speed limit as they claimed that it is either unreasonable or somewhat unreasonable for most cases. Drivers were also asked whether they were satisfied with the speed limit and the reason, if any, for not being satisfied. The data showed that 41.4% of respondents were not satisfied with that speed limit, with 35.7% of the surveyed drivers claimed that the speed limit is too slow and 5.7% of them said that it is too fast. Men said “the 30 km/h speed limit is too slow” significantly more frequently than women did (40.1% of men compared to 28.6% of women, $\chi^2 = 5.00$, $p = 0.025^*$).

5.6. Logistic regression analysis on attitudes towards the 30 km/h speed limit

To gain deeper understandings about the group of drivers who do not support the current speed limit of 30 km/h, logistic regression analyses were conducted. The respondents were divided into two groups. The support group was defined as a group of drivers who were satisfied with the current speed limit or those who stated that the 30 km/h speed limit is too fast. The remaining group, therefore, included people who claimed that the speed limit is too slow. The effects of selected variables that could potentially have influenced attitudes towards the 30 km/h speed limit (expressed by stating whether the speed limit is too slow) were investigated, as shown in Table 6. The descriptive statistics of these variables are in Tables 1 to 5.

Two binary logistic regression models were developed as showed in Table 6. Model 1 included all twenty investigated variables, while model 2 was the final model that included the six variables that were significant at the 5% level. Model 1 identified five significant variables including: “How easy/difficult to avoid speeding? (x11)”, “Residents would feel happy if drivers do not exceed the speed limit (x12)”, “Complying with speed limit would decrease the risk of accidents (x15)”, “Complying with the speed limit would make you uncomfortable (x16)”, and “How acceptable to drive at 40 km/h on 30 km/h streets? (x19)”. The significant predictors in model 2 consisted of all the significant variables in model 1 plus the variable “Police-stopped incident during the last 3 years (x5)”.

5.7. Speed choice factors

Exceeding the speed limit often relates to the way people select their desired speeds on specific driving conditions. The present research investigated drivers' speed choices under a number of circumstances with respect to driving on urban residential streets with a 30 km/h speed limit by asking respondents to indicate whether in each specific situation they would drive slower, the same, or faster than their normal speed. A total of 21 driving scenarios were presented, having 5 answer options ranging from 1. *Much slower* to 5. *Much faster*.

The results provided in Table 7 showed that the circumstances that would make many drivers speed up is “in a hurry” (85%) followed by “street width is wide” (51%) and “the street is free of pedestrians/cyclists” (50%). By contrast, most drivers would reduce their speed when “driving in rain or snow” (96%), “seeing residents at their garden gate” (95%), “driving on a no-sidewalk street with some pedestrians/cyclists along the roadside” (89%), and “driving on an unfamiliar street” (83%). To a lesser extent, 66% of drivers would slow their speeds because of children or elderly people in their car, and 68% of the respondents would do so when the signalised intersection ahead is on red. However, in other circumstances such as “driving on daily commuting streets”, “there are friends in your car”, and “there is only you on the street”, many drivers said they would make no change in their speed choice.

To obtain a deeper understanding of the factors underlying drivers' speed choices, an exploratory factor analysis was conducted. The Bartlett's test of sphericity was significant at the 0.0001 level, and the overall measure of sampling adequacy was 0.76. These

Table 6
Logistic regression analysis on attitudes towards the 30 km/h speed limit.

Independent variable	Description	Possible values	Model 1		Model 2	
			B	P-value	B	P-value
<i>Drivers' attributes</i>						
x1	Gender	1. Female, 0. Male	-.376	.215		
x2	Age	1. <30 to 5. >60	-.123	.331		
x3	Driving frequency	1. Almost every day, 0. Otherwise	-.482	.078		
x4	Real/near-miss accident involvement during the last 3 years	1. Yes, 0. No	-.388	.203		
x5	Police-stopped incident during the last 3 years	1. Yes, 0. No	.389	.232	.622	.039*
<i>Knowledge and opinions about residential streets</i>						
x6	Perceived functions of 30 km/h residential streets	1. Mainly for traffic moving to 5. Mainly for living space	-.030	.849		
x7	Perceived rights of vulnerable street users	1. Definitely agree to 5. Definitely disagree	-.244	.089		
x8	Perceived seriousness of speeding	1. Not a significant matter to 5. Very serious matter	-.103	.418		
x9	Perceived easiness of observing the 30 km/h speed limit	1. Very easy to 5. Very difficult	.060	.728		
<i>Self-reported speeding behaviours</i>						
x10	Frequency of speeding in the past	1. Never to 5. Very often	.214	.199		
x11	How easy/difficult to avoid speeding?	1. Very easy to 5. Very difficult	.364	.049*	.416	.013*
<i>Perceived others' speeding opinions and behaviours</i>						
x12	Residents would feel happy if drivers do not exceed the speed limit	1. Definitely agree to 5. Definitely disagree	.424	.006**	.319	.007**
x13	Pedestrians/cyclists would appreciate drivers who do not exceed the speed limit	1. Definitely agree to 5. Definitely disagree	-.118	.423		
x14	Most people in Saitama City usually break the speed limit	1. Definitely agree to 5. Definitely disagree	-.193	.197		
<i>Attitudes towards exceeding and observing a 30 km/h speed limit</i>						
x15	Complying with the 30 km/h speed limit would decrease the risk of accident	1. Definitely agree to 5. Definitely disagree	.418	.036*	.430	.015*
x16	Complying with the 30 km/h speed limit would make you uncomfortable	1. Definitely agree to 5. Definitely disagree	-.684	.000**	-.653	.000**
x17	Breaking the 30 km/h speed limit would be a high risk of being stopped by police	1. Definitely agree to 5. Definitely disagree	-.145	.212		
x18	Breaking the 30 km/h speed limit would save time and enable you to arrive destination faster	1. Definitely agree to 5. Definitely disagree	-.017	.901		
x19	How acceptable to drive at 40 km/h on 30 km/h streets?	1. Not acceptable to 5. Acceptable	.398	.014*	.395	.004**
x20	Occasionally exceeding the 30 km/h would be socially acceptable	1. Definitely agree to 5. Definitely disagree	.081	.605		
Constant			.070	.967	-2.166	.022*
Sample size (n)			367		367	
-2LL			332.958		350.033	
Cox & Snell R ²			.327		.295	
Nagelkerke R ²			.449		.405	
Omnibus test (χ^2 , df, sig.)			145.347; 20; .000		128.272; 6; .000	
Hosmer & Lemeshow (χ^2 , df, sig.)			4.098; 8; .848		7.339; 8; .501	
Hit ratio (%)			77.9		76.8	

Note.

* $p < .05$.

** $p < 0.01$.

indices collectively indicated that the study data were suitable for an exploratory factor analysis. The final model resulted in six extracted factors, as provided in Table 8, where all had an eigenvalue greater 1.0 based on a scree test. Three items, "driving on beautiful streets with trees or buffer plants", "driving under rain or snow", and "sidewalk is available" did not have loading factors of more than 0.30 for any factors and were thus excluded from the analysis. The final model can explain 61.5% of variance and all loading factors were greater than 0.5.

6. Discussion

General knowledge and opinions about residential streets with a 30 km/h speed limit were surveyed. This study showed that not all drivers perceived well the intended functions of 30 km/h residential streets. When asked about the functions of these streets, only 24% of respondents said their use for residential activities was more important while still 19% said their use for traffic was more important.

Presuming that the perceived functions of streets influence driving behaviour, drivers should be better educated about residential street uses to reduce bad driving manners. On the positive side, this research revealed that drivers tended to respect the rights of vulnerable street users as a majority of respondents agreed that motorists should give priority to pedestrians/cyclists anywhere they are encountered on 30 km/h residential streets.

As expected, the survey results showed that drivers were likely to recognise speeding on neighbourhood streets as a serious matter. When respondents were asked about the most effective way to solve speeding issues, less than 10% of the drivers relied on reinforcing police patrols or increasing traffic-law-breaking fines. This finding may reflect the fact that people in Japan are rarely stopped by police because of speeding on residential streets with a 30 km/h speed limit. Consistent with Stradling et al. in 2003 [6], a majority of respondents in the present research suggested either redesigning streets to make them inherently calmer or installing traffic calming tools as the most effective anti-speeding interventions. This finding suggests

Table 7
Drivers' speed choice on specific circumstances.

Circumstances	Frequency (%)			Mean	SD
	Slower	Much the same	Faster		
1. You are driving under rain or snow	96	4	0	1.71	0.57
2. Seeing residents doing something at their garden gate	95	5	1	1.81	0.55
3. Driving on a no-sidewalk street with some pedestrians/cyclists along the roadside	89	10	1	1.83	0.65
4. Driving on an unfamiliar street	83	17	1	2.11	0.55
5. The signalised intersection ahead is on red (you are still far away from the stop line)	68	30	2	2.23	0.66
6. There are children/elderly people in your car	66	34	0	2.26	0.61
7. The traffic ahead is moving slower than you normally drive	47	39	14	2.64	0.76
8. When you think there are likely patrol polices somewhere on the driving street	47	53	0	2.46	0.63
9. Sidewalk is available	46	40	14	2.63	0.78
10. Driving on beautiful streets with trees or buffer plants	43	56	1	2.54	0.60
11. There are friends in your car	31	69	0	2.67	0.53
12. Street width is wide	5	44	51	3.47	0.65
13. The street is free of pedestrians/cyclists	4	46	50	3.48	0.64
14. You are in bad temper	4	62	34	3.36	0.64
15. There is only you driving on the street	4	66	30	3.27	0.60
16. You are feeling excited	4	51	46	3.47	0.65
17. Someone is driving too close behind you	4	57	39	3.36	0.61
18. You are in hurry	3	12	85	3.93	0.59
19. The vehicle ahead is moving faster than you normally drive	2	62	37	3.38	0.56
20. The signalised intersection ahead is on green time	1	57	42	3.42	0.58
21. Driving on daily commuting streets	1	71	29	3.29	0.48

that drivers tend to push responsibility onto urban planners and street designers to make the 30 km/h speed limit more credible. However, the survey showed that 23% of respondents believed that excessive speeds could effectively be solved by raising drivers' awareness about their potentially bad consequences. This result supports the introduction of educational measures and social campaigns to cope with driving violations, as often shown in the literature.

This research revealed drivers' perceptions about the easiness of observing the 30 km/h speed limit on a given driving street section. The results indicated that approximately a third of drivers still had problems to observe that speed limit. This means it is necessary to provide more information and/or traffic signs to clearly distinguish 30 km/h streets from others on urban street networks because drivers may unintentionally speed, as noted by EKOS Research Associates in 2005 [13].

The present research confirmed that almost all drivers had exceeded the speed limit on urban residential streets with a 30 km/h speed limit and that they intended to do so in the future if nothing is changed. This fact raises a question about the credibility of this speed limit in Japan and it calls for more attention to this issue. As expected and consistent with past research [22], women tended to speed less frequently than men. Interestingly, the frequency of speeding in the future time stated by drivers significantly reduced after these drivers participated in the survey. These findings also support the need for public awareness programmes and social campaigns as ways of altering speeding behaviour.

Although drivers tended to favour speeding, they are likely to have ability to not speed as more than half of the surveyed drivers stated that it is easy or somewhat easy for them to control their speeding behaviour if they so desired, compared to only approximately 15%

Table 8
Factors influencing drivers' on-street speed choices.

Circumstances	Factors					
	1	2	3	4	5	6
	Favourable driving conditions	Current mood	Responsibility for others	Responsibility for safety of vulnerable street users	Unfavorable driving conditions	Traffic situation
1. The street is free from pedestrians/cyclists	.78					
2. Driving on daily commuting streets	.69					
3. The signalised intersection ahead is on green time	.64					
4. Street width is wide	.60					
5. There is only you driving on the street	.59					
6. You are feeling excited		.85				
7. You are in bad temper		.84				
8. You are in hurry		.70				
9. There are children/elderly people in your car			.79			
10. There are friends in your car			.77			
11. When you think there are likely patrol polices somewhere on the driving street			.71			
12. Driving on a no-sidewalk street with some pedestrians/cyclists along the roadside				.89		
13. Seeing residents doing something on their garden gate				.88		
14. The signalised intersection ahead is on red (you are still far away from the stop line)					.87	
15. Driving on an unfamiliar street				.32	.58	
16. Someone is driving too close behind you						.75
17. The vehicle ahead is moving faster than you normally drive						.57
18. The traffic ahead is moving slower than you normally drive						-.56

Note: Factor loadings less than 0.30 have not been printed.

stating an opposite opinion. This finding implies that for many drivers, their speeding behaviour may mainly depend on their own internal factors such as their speeding attitudes and speeding intention.

Consistent with previous research [9–11], drivers were likely to claim that other drivers were speeders. A majority of respondents (68%) agreed that most people in Saitama City usually exceed the 30 km/h speed limit, while only 7% of them disagreed to any extent. However, drivers seem to understand that their speeding behaviour may cause harm to vulnerable street users and residents because more than 60% of the respondents agreed that these un-protected people would appreciate or feel happy if drivers observe speed regulations.

On the one hand, a majority of drivers (69%) believed that occasionally committing a speeding violation is a socially acceptable action and more than a third (38%) said it was acceptable for them to drive at 40 km/h on streets with a 30 km/h speed limit. On the other hand, this study also found that drivers had positive beliefs about complying with the speed limit. Most respondents (86%) believed that observing the 30 km/h speed limit would decrease the risk of accidents, and only 11.7% said meeting the speed limit would make them uncomfortable.

With respect to exceeding the 30 km/h speed limit, a majority of drivers (63%) perceived that this driving violation would result in a high risk of being stopped by police, but a number of respondents (65%) believed that they could save time and arrive at their destination more quickly by speeding. In a study conducted by Wallén Warner and Åberg in 2008 [12] about beliefs concerning breaking the speed limit in urban street environments, only the belief “make me arrive quicker” significantly predicted both the direct measures of speeding attitudes and speeding intentions. Therefore, for anti-speeding interventions targeted at residential streets with a 30 km/h speed limit, the findings from the present study suggest that attention should be paid to drivers' time-saving beliefs because the majority of people assumed that this benefit could be gained from speeding, despite the fact that travel time is often unchanged or even marginally improved if the speed limit is observed, as shown in a 2002 study by Elmkvist (cited by Wallén Warner and Åberg in 2008 [12]).

In accordance with previous studies [19,20], this research confirmed the support for the 30 km/h speed limit from drivers because a majority of them stated that the current 30 km/h speed limit is appropriate for most cases. However, 35.7% of respondents were concerned that the 30 km/h speed limit is too slow for traffic. To identify drivers who do not support the current speed limit of 30 km/h, binary logistic regression analyses were conducted in this study. The results indicated that drivers who stated “the speed limit is too slow” are significantly associated with those who have been stopped by police during the last 3 years. One possible reason for this finding is that drivers who had been involved in a police-stopped incident are likely those who have a tendency to violate traffic laws including speed limit regulations, and thus they often use external conditions such as “the speed limit is too slow” to justify their violations. This has been observed in previous studies [13,14]. As expected, the logistic regression models also showed that drivers who do not support the speed limit are likely those who did not believe in the traffic safety benefits of observing the speed limit (i.e., complying with the speed limit would decrease the risk of accident), and also those who believed that complying with the speed limit would make them uncomfortable. Furthermore, the extent to which people believed it is acceptable for them to drive at a high speed of 40 km/h on 30 km/h residential streets, and the extent to which drivers felt it was difficult to avoid speeding significantly distinguished the group of drivers who support the 30 km/h speed limit from those who do not support it. As expected, drivers who stated “the speed limit is too slow” are likely associated with those who tended to accept the high speed and who had difficulty refraining from speeding. Lastly, more extent respondents disagreed that residents would feel happy if drivers do not exceed the speed

limit, more likely they were to belong to the group that does not support the current speed limit. Overall, the findings suggest that driver training programmes and social campaigns that aim to increase the public consent about the 30 km/h speed limit should focus on the target groups noted in this study.

As expected, women tended to have more positive perception regarding speeding than men. This research revealed that women exceeded the 30 km/h speed limit significantly less frequently than men and women were significantly more confident than men with regard to perceived difficulty of refraining from speeding. By contrast, men tended to agree with the time-saving benefit from breaking the speed limit more than women did, and men claimed that “the 30 km/h speed limit is too slow” significantly more frequently than their counterparts.

The present research also investigated drivers' speed choices in various circumstances with respect to driving on residential streets with a 30 km/h speed limit. As consistent with previous studies [6,15], scenarios that most encouraged drivers to change their normal speeds were “being in a hurry” (going to a higher speed) and “driving under rain or snow” (going to a slower speed). In addition, more than half of the drivers would speed up if the “street width is wide” or the “street is free of pedestrians/cyclists” while in contrast, most of them would slow down if they are “seeing residents at their garden gate” or “driving on a no-sidewalk street with some pedestrians/cyclists along the roadside”. The findings suggest that we might change vehicle speeds by redesigning streets and/or encouraging more vulnerable street users' activities on these roads.

To extract the underlying factors that influence drivers in selecting their speeds, an exploratory factor analysis was performed. The results identified six distinguishable factors that affect drivers' speed choices. As showed in Table 8, all items in factor 1 represent driving conditions that likely make people drive faster, so it is reasonable to label factor 1 as “favourable driving conditions”. By contrast, factor 5 should be labelled as “unfavourable driving conditions” because the two items in this factor are circumstances that tend to cause respondents to reduce their speeds. The three items in factor 2 could be combined under the label of “current mood” in accordance with Stradling et al.'s study in 2003 [6]. Factor 3 was labelled as “responsibility to others” because its three items consistently indicated that drivers' speed adjustments are the results of their feelings of duty or obligation either towards others who are present (i.e., friends, children/elderly people) or enforcement authorities (i.e., police), as suggested by Stradling in 2007 [15]. Factor 4 is composed of two items that represent drivers' speed choice as a response to ensure safety for vulnerable street users; therefore, there is a good reason to label this factor as “responsibility for safety of vulnerable street users”. Finally, factor 6 was labelled as “traffic situation” because all three items in this factor relate to traffic conditions that influence driving speeds. The factors for reasons for changing speeds explored in this study clearly present the nature of drivers' speed choices when driving on 30 km/h urban residential streets. These findings also can be used to identify appropriate measures to cope with speeding problems.

7. Conclusions

This study is the first attempt to explore drivers' opinions, attitudes, and behaviours with respect to speeding and driving on urban residential streets with a 30 km/h speed limit. The research confirmed that almost all drivers had exceeded the speed limit and that they intended to do so in the future if nothing is changed. Drivers tended to have positive beliefs about complying with the speed limit and to understand the negative consequences of speeding, but a majority of them believed that breaking the speed limit would reduce their travel time. Although the extent of speeding that occurs was found to be very serious, a number of drivers still supported the use of the 30 km/h speed limit and they also favoured protecting the rights of vulnerable street users. Further

analyses in this study identified the group of drivers who do not support the current 30 km/h speed limit as those who had committed traffic-law violations, who had negative beliefs about complying with the speed limit, who did not consider residents' opinions, who believed it is acceptable for them to drive at a high speed, and who felt it difficult to refrain from speeding. With regard to anti-speeding countermeasures, under drivers' point of view, streets should be designed to make the 30 km/h speed limit more credible, although this study also showed evidence supporting the application of public awareness programmes and social campaigns as speeding interventions. Finally, six underlying factors affecting drivers' speed choices were identified to clearly present the nature of speed choices on 30 km/h residential streets, including favourable driving conditions, unfavourable driving conditions, drivers' current mood, responsibility to others, responsibility for safety of vulnerable street users, and traffic situation.

Although the findings from this study provide helpful information for urban planners, policy makers, and other people who want to introduce the 30 km/h speed limit on urban residential streets or to address speeding issues in similar conditions, there should be an awareness of several limitations when the results were interpreted. A selection bias may exist because this study used data from only drivers in Saitama City with a low usable response rate of 32.1%. An example of the selection bias is that only 11 drivers under 30 participated, well below the expected number, implying that younger drivers' attitudes are underrepresented in this study. Suggestions for future work therefore include conducting a survey on a large scale with a large sample size and focusing on sub-groups of drivers (e.g., age, gender, etc.) to provide more insights about speeding and driving perceptions on neighbourhood streets.

Notations

* $p < .05$.

** $p < .01$.

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