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Walking Behavior of Residents Around Railway Station

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Abstract: This study aimed to explore walking as a transportation mode compared with other modes of election for residents around Kiaracondong railway station, Bandung with comparative and descriptive analysis. Initially, the use of modes that will be compared to walking is walking plus train, walking plus angkot, walking plus ojek/others and car/motorcycle. But the train was not a daily trip for people around the station so it is not analyzed further. Walking as transport mode explored by trip purposes (school, shopping, work), gender (male, female) and the availability of car/motorcycle. Walking into that has been chosen, except for the purpose of working. We then discuss aspects of parental perception of walkability are grouped into five, namely accessibility, comfort, safety, pleasure ability and security. From the perception of walkability, only feasibility for walking to distance associated with walking which is one factor accessibility. While the gender and availability of car/motorcycle has nothing to do with the election of walking as mode of transport.

Key words: Walking, walking behavior, walkability, mode choice, parental perception

INTRODUCTION

In the past this decades, walking becomes a research objects in many perspective such as walking as transportation also known as a part of an active transport. Many researches do research about walking that motivated by the environmental goal as same as this research.

Many studies has been done as a way to achieve active transport, especially how to understand walking behavior, including the factors that influence it. Factors found to influence people to walk is included variables of built environment (Handy *et al*., 2006; Alfonzo *et al*., 2008; Saelens and Handy, 2008; Cervero *et al*., 2009), besides of socio-demographic factors. These built environment variables also can be influenced by traffic and other conditionsn so it reflects the level of safety (Zhou *et al*., 2010). Besides, psychology or self-selection also role to encourage people who want and like walking to associated in with the built environment (Handy *et al*., 2006; Dill *et al*., 2014; Sun *et al*., 2015). The built environment condition in a neighborhood or several area that make people easy to walk can be categorized as the walkable neighborhood an area that has a good walkability. Even it has been discussed but there is not a standard definition for it yet. For this research, walkability is the quality of walking conditions, including safety, comfort and convenience (Litman, 2014; Abdul *et al*., 2015).

As walking is an access mode for using the public transportation, walkability also affect the use of public transportations (Ryan and Frank, 2009; Daniels and Mulley, 2013; Wibowo and Olszewski, 2005). That is why this research uses people around the Kiaracondong Train Station as the object.

As other cities in Indonesia, concepts of the development that integrate land with public transportation services have not been adopted well in Bandung. The watch of walkability is not maximal yet. So then, empirical proofs of walking behavior are needed, either as a primary or secondary mode or even as an access mode for public transportations includes train, etcetera. This empirical proof can be useful as the input of walking strategy as the active mode that support future transportation.

There are two reasons that into consideration to establish areas around the residence of Kiaracondong Railway Station as the study area. The first is that this station is the second largest station in the city of Bandung, after Bandung Railway Station. Secondly, this region naturally has grown with the population density is high, i.e., 21.569 inhabitants/km^2 (Bandung City in Figures, 2015) with various types of land use. The population density and diversity of land use are the two variables that included walkability characteristics (5 Dsconcept) expended by Cervero *et al*. (2009). However, conditions in Indonesia is different from the country that have implemented the concept of integrated development of the use of the railway to the area around the station. Initially, the railway mode is considered as one option for residents around the station. However, due to the pattern of use of the train instead of their regular trips, the train is not

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Table 1: Some previous researches about relation walking behavior and walkability

Sources	Sample	Research area	Scale and approach of walkability measurement	Walking behavior	Trip purposes	Walkability variables/parameters
Park *et al.* (2015)	Transit users	Mountain view, California, USA	Micro-level, objective	Access mode choice	Work and others	Sidewalk amenities traffic impacts Street scale and enclosure Landscaping elements
Cervero *et al.* (2009)	Pejalan dan pengguna Sepeda	Bogota, Colombia	Meso-level, objective	Walking and bicycling as mode choice	Utilitarian purposes	Density diversity design distance (to transit) destination accessibility
Alfonzo *et al.* (2008)	Adult parents	Some suburbans in USA	Micro-level, objective	The number of weekly typical walking trips	Destination walking and recreation walking	Accessibility safety comfort pleasure-ability
Lin and Yu (2016)	Children	Taipei, taiwan	Micro-level, objective	Trip mode (walking, biking, transit)	Leisure trip	Intersection density Traffic density leisure trip distance walkway width Walkway quality mixed land use building density employment density
Mehta (2008)	Pedestrian in main stress	Main streets in some cities, USA	Micro-level, subjective	Walking needs-pedestrian volumes	Walking in main streets	Accessibility, feasibility; usefulness; safety; comfort; sensory pleasure; sense of belonging
Zhou *et al.* (2010)	Elementary and middle students	Florida, USA	Micro-level, subjective	Walking/biking rates	To school	Safety security
Dill *et al.* (2014)	Women and older adults	Neighborhoods in Portland, USA	Meso-level objective	Frequency of walking bicycling	All purposes	Street connectivity destination nearby Low traffic streets
Handy *et al.* (2006)	Residents	Traditional and suburban neighborhoods in Nothern California, USA	Micro-level, subjective and objective	Frequency of walking to store	Utilitarian purposes	Subjective: accessibility Physical activity options Safety socializing outdoor spaciousness attractiveness Objective: Number of types of establishments (400, 800, 1600 m) Number of establishments (400, 800, 1600 m) minimum distance in meters to establishments
Walton and Sunseri (2010)	Drivers and walkers	Auckland and Wellington, New Zealand	Micro-level, subjective	Access mode choice	To work place and school	Distance to walk the train station
Ryan and Frank (2009)	Bus users	San Diego, USA	Meso-level, objective	Access mode choice	All purposes	Residential density Retail floor areas ratio Intersection density Land use mix

defined as a mode are discussed. This is in accordance with the findings of previous studies that a train passengers at the station of Kiaracondong come from more distant areas of the station (Syafriharti, 2015).

In that case, the research questions are: How walking behavior as an active transport for the routine journey? How the occupants think about walkability in their neighborhood with walkability variables, like accessibility, comfort, safety, pleasure-ability and security? Which walkability variables are associated with walking behavior? A routine trip in this research means for utilitarian purposes which means work, school and shop. Scope of walking behavior that will be examined include selection of walking as a transport mode based on trip purpose, gender and the availability of self-owned vehicles (car or motorcycle) for traveling. Furthermore, there will be the analysis of walkability relationship with the choice of walking as modes of transport through comparison and descriptive analysis regarding exploration walkability assessment. For exploration, walkability measured at the micro level based on the subjective assessment of parents (respondents) on the parameters that have been defined.

Literature review: Walking behavior that has been studied previously there was about walking as the main mode (Alfonzo *et al.*, 2008; Lin and Yu, 2011). There is also about walking as access mode, good for train users

(Park *et al*., 2015; Walton and Sunseri, 2010; Ryan and Frank, 2009). Cervero did a research on walking as main mode and access mode as well.

Research about walking also called as biking (Cervero *et al*., 2009; Lin and Yu, 2011; Zhou *et al*., 2010; Dill *et al*., 2014). Populations and sample also various, some using children or even adults. Over all, trip purposes of people who choose walk as the transport mode is for utilitarian (working, shopping, school) and non-utilitarian purposes (leisure activity). In the previous research about the relation or effect of walkability on walking behavior or travel behavior generally, walkability measurement becomes an important phase. Therefore, many methods used to find walkability index and explore the relations with walking behavior. From all those researches, the walkability measurement can be distinguished by the scale of the detail and measurement of approach. Based on the scale of the detail, walkability can be measured at the level of meso and micro (Park *et al*., 2015). In meso-level, walkability can be measured by the attributes of urban form as used by Cervero *et al*. (2009) which are density, land use mix, street patterns, destination accessibility and distance to transit. The data for meso-level obtained objectively and can utilize the GIS. On the micro-level is used as a measure of the characteristics of urban design as done by Alfonzo *et al*. (2008) and Park *et al*. (2015). Unlike the meso-level, measuring walkability on the micro-level can use objective or subjective approach. If an objective approach using a predefined size prior to a certain standard then the subjective approach is based on the perceptions and preferences of people walking. Besides, objective measurement can be a quantitative or qualitative data.

Walkability variables and parameters are defined at each study depends on the purpose and scope of the research. Walking distance became the most widely used parameter for assessing the walkability. Besides a study assessing the walkability to explore their influence on walking behavior there is also a study whose purpose was to discuss about how to measure the walkability, including Global Walkability Index (Krambeck, 2006) which is used by Luadsakul and Ratanvaraha (2013) with the component assessment consists of safety and security, convenience and attractiveness and policy support. In Indonesia, Wibowo *et al*. (2015) are assessing the walkability in several locations in Bandung with the parameters of pedestrian conflict with other motorized modes, presence walking facilities, crossing availability, safe crossing, motorist behavior, amenities walking, walking infrastructure for disability, obstruction and walking secure. Both Luadsakul and Ratanvaraha or Wibowo *et al*. assess walkability on a micro-level and with the objective approach.

Besides the variety of methods used to measure, analysis techniques to examine the relationship walkability by walking are also diverse, even not just a relationship but it produces the effect of certain parameters on the walking behavior. Each level and measurement approaches have advantages and disadvantages. The most ideal is combine all the methods of the measurement but with limited resources, the selection methods must be done in accordance with the purpose of research (Table 1).

MATERIALS AND METHODS

In total 200 survey respondents who is the father or mother in the family who live in the surrounding of Kiaracondong railway station area in Bandung area (about a radius of 1 km). They gave a data about family social-characteristics, trip behavior of themselves and all the family members also give assessment about walkability around their neighborhood. Survey was done in a week by visiting the respondent's house and the surveyor guides them to answer the questionnaires.

In this research, walking behavior is the proportion of the election where walking as a daily transports which can be divided into mode choice during weekdays and weekends. Trains have been out of the transportation routine mode because based on the last survey, walking and angkot (public transportation), walking and ojek or else also private car or motorcycle was chosen as a routine transportation.

Walking behavior: Mode choice for routine trip; (walking = 4, walking+angkot = 3, walking+ojek/others = 2, car/motorcycle = 1).

Socio-demographic characteristics: (Female (0,1), No availability of cars/motorcycles (0, 1)).

Trip purposes: (school = 3, shopping = 2, work = 1).

Perseptions of walkability

Accessibility:

- Availability of sidewalks
- Distance to destination (feasibility for walking to destination)

Comfort:
- Sidewalk width
- Trees
- Availability of benches for rest
- Free from parking vehicles and street vendors
- Cleanliness

Safety:
- Sidewalk buffers
- Paving treatment
- Driver attitude
- Availability crosswalks
- Special lanes for disabilities

Pleasurability:
- Design of the built environment
- Design and color of sidewalk and crosswalk
- Design of the other facilities

Security:
- Availability of street lights
- Vacant buildings
- Empty land

(Very good = 5, Good = 4, Moderate = 3, Poor = 2, Very poor = 1)

Explanation:
- Angkot: public transportation/paratransit
- Ojek: public transport is not an official in Indonesia such as motorcycles are rented by the way give a lift passengers
- Others: school shuttle car, employee shuttle car
- Shopping: to traditional market, to mini market, to small shop, to shop, etc

Purpose of the routine travel (daily) divided into activities to go to school, work and shop/others. The shopping activities are for shopping to traditional markets, mini markets or others. Socio-demographic characteristics in the family consist of the sexes and the availability of private vehicles, either cars or motorcycles. For walkability measuring, the various components of the measurement that has been used before is determined using the accessibility, safety, comfort, pleasure-ability, and security. And then, eight-teen items that developed by five categories of influences on the mode choice of the routine trip and requested an agreement on a 5-point Likert scale from "very good to very poor". Walkability is only judged by the head of the only family (father or mother) who filled out a questionnaire. Analysis method that used is comparison and descriptive analysis for these points:

- The proportion of walking as modes of transport on weekdays and weekends when compared with other modes
- The proportion of walking as a mode of transportation for each trip purposes during weekdays
- The proportion of walking as a mode of transport based on gender during the weekdays and weekends compared to other modes
- The proportion of walking as a mode of transportation based on availability of cars/ motorcycles during weekdays and weekends compared to other modes
- The perception of walkability for each assessment item and choosing the most influential factor in the selection of walking as a mode of transport
- The perception of walkability of the most influential in the selection of modes for each trip purposes during weekdays

RESULTS AND DISCUSSION

From 200 respondents was obtained data on 728 trips but as many as 10 people very rarely make the trip because they are still very young or very old or sick. Thus, only 718 data to be analyzed, both for trips during weekdays and weekends, however at weekends, around 55 people less traveled so it is considered not traveling.

The survey results in this study strengthen the survey conducted on pedestrian around railway station Kiaracondong (Syafriharti, 2015). The results of the previous survey discovered only very few people around who are traveling by train and the current study found that the train is not a mode for regular movement of people around the station. Therefore, the modes will be analyzed only 4, i.e., walking, walking and public transport (angkot), walking and ojek/others and automobile/motorcycle.

Walking as a mode choice: Dominant mode selected is walking for travel and the number of walkers increases during weekends. Angkot and ojek/other by walking as a secondary mode do not have a lot of choice. Pattern mode this choice shows that there are only (2) modes are the main options, namely walking and self-owned vehicles (Fig. 1).

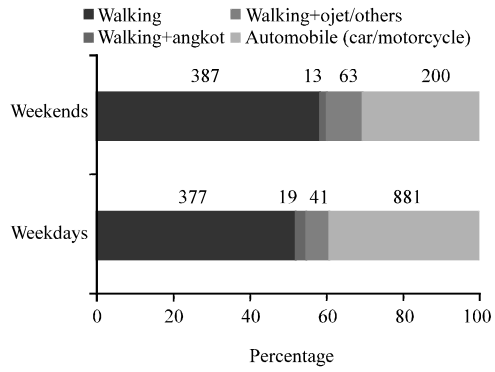

Fig. 1: Number and percentage mode choice on weekdays and weekends

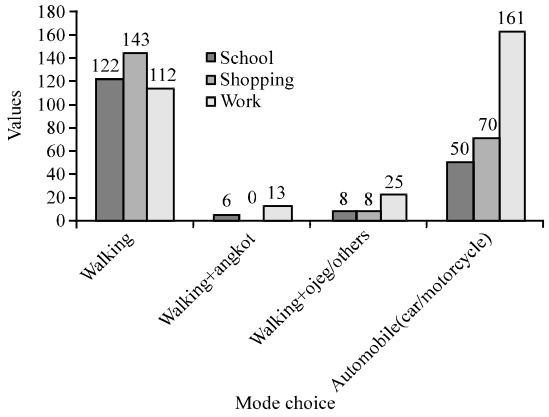

Fig. 2: Number of modes by trip purposes on weekdays

Walking and trip purposes on weekday: From the three trip purposes studied, that is 'to school', 'to traditional market or shopping' and 'to work place', appears that the selection of walking as transport mode is almost the same for all trip purposes, even for a little more for shopping. In contrast of private vehicles and others that was chosen for work (Fig. 2).

Walking by gender: No differences in mode choice for both male and female. For walking or other modes, the number of male users is almost the same with female. Only, if explored in more detail, there are differences in the use of private vehicles which means that male more as a driver while more females are as passengers (Fig. 3 and 4).

The same pattern also showed at the weekends. However there are some conditions that different from the current weekdays. The first is that ojek are an alternative mode for males to make the trip. Second, more females are choosing to stay home during the weekends than males.

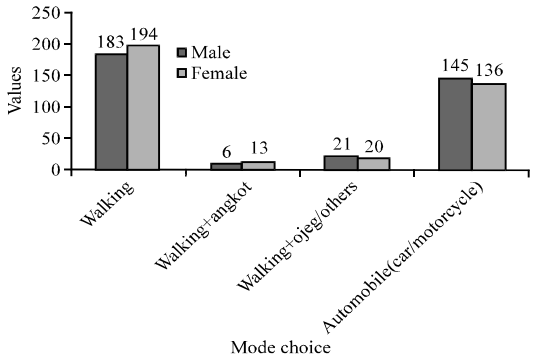

Fig. 3: Number of modes by gender in weekdays

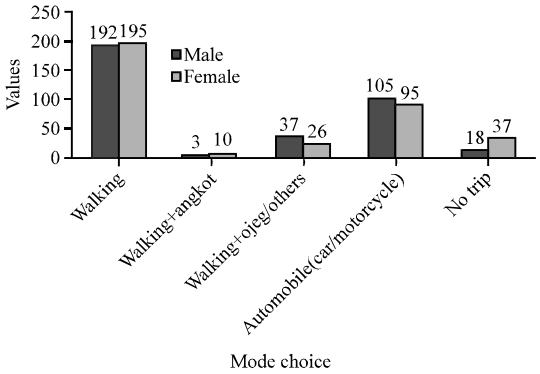

Fig. 4: Number of modes by gender in weekends

Walking and availability personal car or motorcycle: The vailability of personal car or motorcycle can be used by people who live around Station Kiaracondong quite high, reaching 82%. When compared with the use of private vehicles which only reached 39% during weekdays and 30% during the weekends, this condition shows that the availability of private vehicles does not necessarily cause people to choose to use private vehicles to travel. Walking in choosen as mode of transportation that has the ability of private vehicles even it reaches almost 70%. So there is no relationship between the availability of private vehicles with walking as a transportation mode (Fig. 5).

Parent's perceptions of walkability: Of the 18 items assessed, almost all provide assessment "very poor". In total the number of modal choice goes for transportation, assessing the walkability factors have nothing to do with mode choice. Items that gained a pretty good assessment are the "cleanliness" and good for "distance to destination (feasibility for walking to destination)". Both of these factors elicit "very poor" at least. The factor "distance to destination" even elicits "very poor"

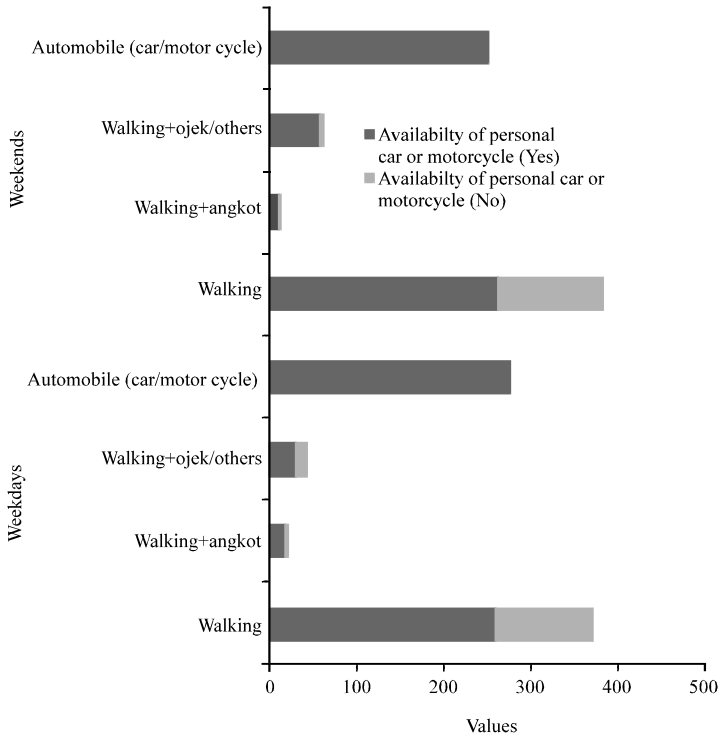

Fig. 5: Number of modes by availability personal car or motorcycle parent's perceptions of walkability

<15%. Therefore, these factors can be said to be the most pertinent factor and influence people to choose walking as mode of transport. Therefore for these factors will be explored further to do walking behavior (Fig. 6 and 7).

For the family members who walking looks anything to do with the assessment of parents about the distance to the destination. It can be seen from the perception that is dominated by the very good and good. For those using walking+angkot are also something to do because the ratings are not good for the distance to transport which means that far to walk so they prefer not to walk. That look no correlation between the perception of distance to destination with a modal choice is choosing car/motorcycle and walking+ojek/others for modes of transport because of the perception of parents about these factors is not too bad.

From this walkability assessment can be seen that between the distance to school with a modal choice has a relationship. Children or other family members go to school by walking when the perception of parents about the feasibility for walking is good while will choose other modes because of the perception of parents about the feasibility for walking bad (Fig. 8).

It is different with the traveling for shopping. Feasibility assessment destination for walking to many of the category of "very good" but the mode selected by family members not only walking also walking+taxi/others and car/motorcycle. For the purpose of working which is most associated between parent's assessment of the feasibility for walking to destination is that his family members choose walking and walking+angkot. For car/motorcycle also quite related but walking+ojek/others not too have a relationship because an assessment of the distance factor is pretty good (Fig. 9).

Both male and female, the choice mode to be in touch with parents about the feasibility assessment is for walking to a destination. Elections walking as a mode of transport for the family members who have the opportunity to use private vehicles and that is not also equally have a relationship with parents about flexibility chooses for walking to a destination.

Walking as a primary transport mode was chosen by residents around Kiaracondong station. There is a difference between walking behavior during weekdays and weekends. During the weekdays known the trip purposes because of the travel is a routine utilitarian trip,

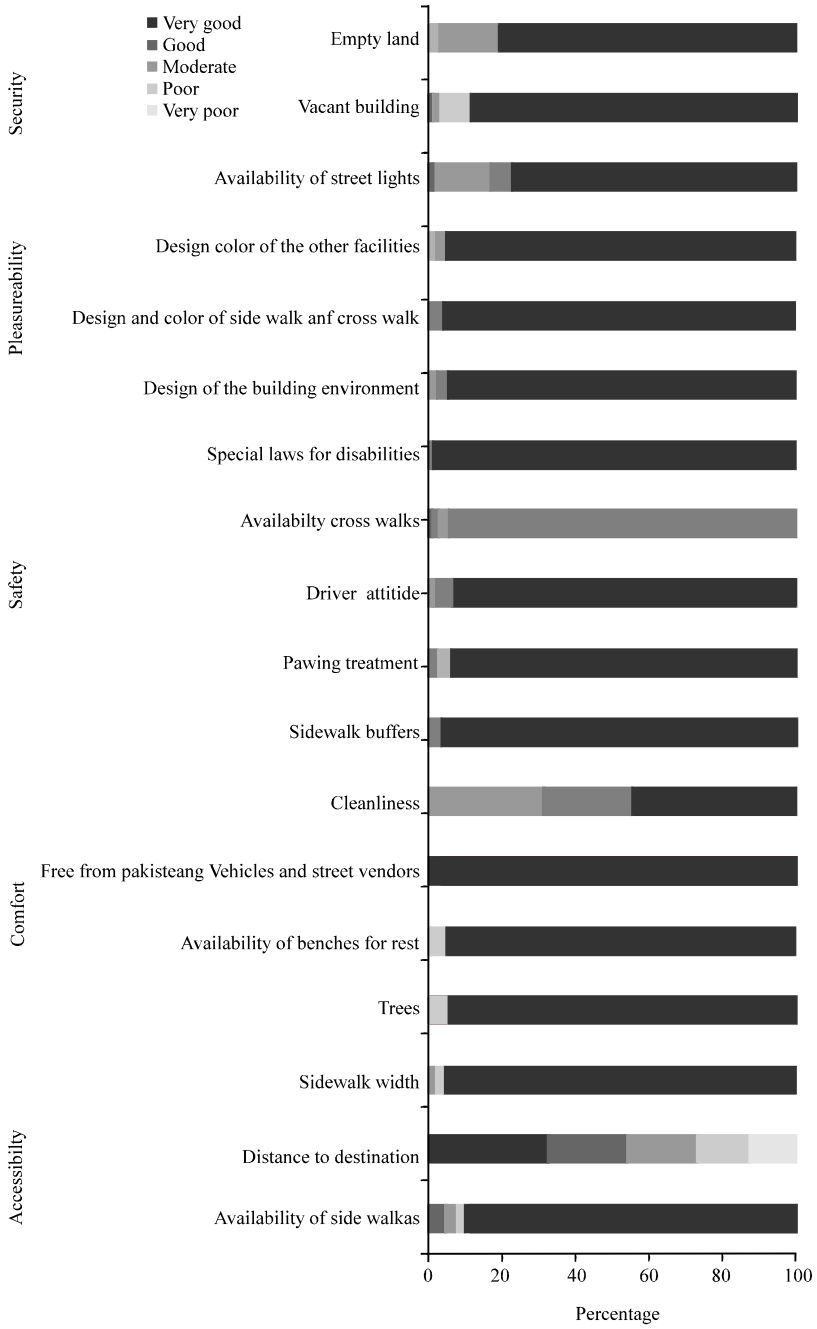

Fig. 6: Walker parent's perception of walkability

while the weekend is not always utilitarian purposes. For school and shopping purposes, walking is the most selected mode, rather than other modes, unlike the case for the purpose of work, walking mode is fewer than not car/motorcycle.

Not much different between male and female in choosing walking as a transport mode, showing that there is no gender relationship with the walking behavior. The next finding from this study is that the availability of car/motorcycle does not cause people to choose the car/motorcycle as a mode. So, there is no connection between the availability of car/motorcycle with the walking behavior (Fig. 10).

Walkability turned out to have nothing to do with the walking behavior, because despite walkability assessment of bad, still a lot of walking. The only factor

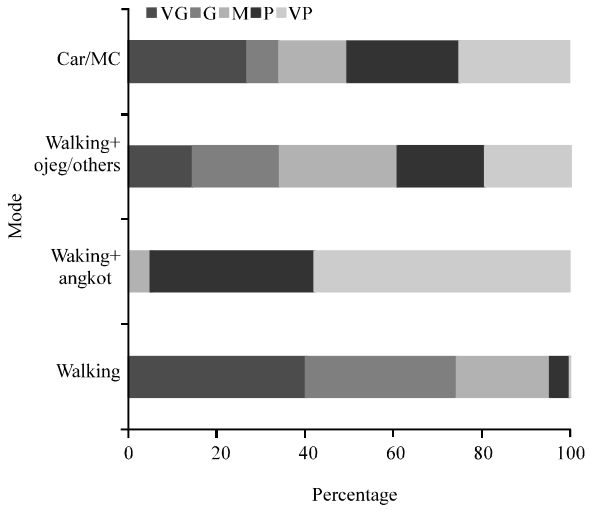

Fig. 7: Parent's perception of distance to destination (feasibility for walking) for each mode

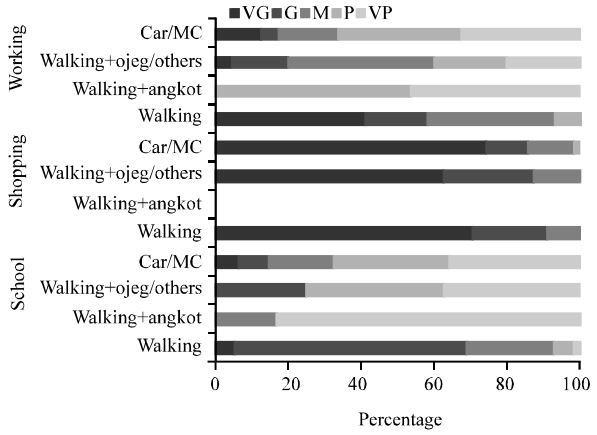

Fig. 8: Parent's perception about distance to destination (feasibility for walking) for each mode based on trip purposes

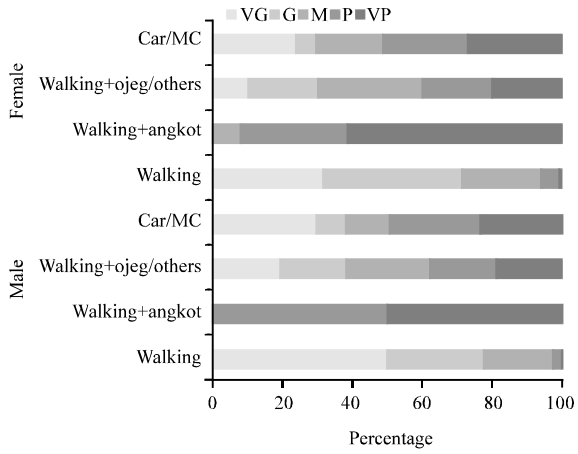

Fig. 9: Parent's perception about distance to destination (feasibility for walking) for each mode based on gender

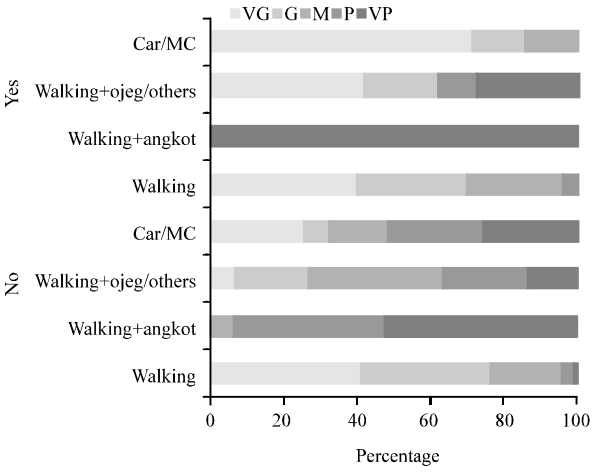

Fig. 10: Parent's perception of distance to destination (feasibility for walking) for each mode based on availability of car/mc

walkability that has a relationship with walk is feasibility for walking to a destination both seen by trip purposes, gender as well as availability of car/motorcycle.

Based on these findings, policy makers should be able to improve other factors of walkability so quality of walking experience better. That requires more research to understand walkability comprehensive and the influence walking behavior. Need coupled between subjective and objective approach to gain a better understanding.

CONCLUSION

Overall, walking is the mode that has been chosen and is more widely used as a primary rather than secondary mode by residents around the railway station Kiaracondong. For the purpose of schools and shopping is the most preferred mode is walking but not for work, even though the number of choosing are also many. Male or female are also as many who choose walking as a mode, even that has availability of car/motorcycle are also choose walking as a mode. In general there is no relationship between walkability with the election of walking as a mode, only the feasibility factors for walking to distance that has to do with walking as modes.

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