PEDESTRIANISATION PROGRAMS AND ITS IMPACTS ON THE WILLINGNESS TO INCREASE WALKING DISTANCE IN INDONESIAN CITIES

The case of Bandung City and Bogor City, Indonesia

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ABSTRACT

Recently, several cities in Indonesia have begun implementing pedestrianisation program that hold promise to encourage non-motorized transport (NMT) in rapidly motorizing cities and provide citizens with safer, cleaner, and more visually appealing walking environments. However, successful implementation of these programs depends on whether they meet the needs of urban residents. This article assesses how Bandung and Bogor. Indonesia are meeting those needs with pedestrianization programs known as “Panca Trotoar” in Bandung and “Walkable Bogor” in Bogor. The article employs two methods to analyze the programs’ impact. First, it draws upon responses to face-to-face interviews and analytical hierarchy process (AHP) to rank possible barriers to walking in Bandung. The results of the AHP reveal that safety and security Sustainable Development Goals (SDG 16.1.4) as the highest rank among six potentially influential factors (the other factors were feasibility, accessibility (time spent walking), comfort and pleasure). This result contrasts studies in other cities that suggest feasibility and accessibility rank highest in decisions to walk. The article then employs an ordered logit model to quantitatively assess how improvements to the pedestrian environments influence the willingness to walk longer distances in Bandung and Bogor. The result shows the increasing of willingness to walk among walkers are more than double the amount of the non-walker group or about 424 meter per day in Bandung city while the increasing distance to walk is slightly lower or around 10.9% in Bogor. The logit model shows that older people were willing to walk further, while respondents who walk shorter distances were unlikely to change that behaviour. The model also highlights notable variables which may play a significant role in a certain place and group of respondents and also interaction between some variables, for instance, illustrating that female vehicle owners were less inclined to walk further even with improvements to the pedestrian environment in some places. The analysis could prove helpful to other rapidly motorizing cities considering similar NMT programs in Indonesia and other cities in Asia.

Keywords: Pedestrianization program, willingness to walk, ordered logit, sustainable development goals, Bogor City, Bandung City.

1. INTRODUCTION

Asia’s cities have traditionally been walking cities. To this day, many of Asia’s urban dwellers rely on walking and cycling to get from place to place. However, with rapid motorization and limited attention to pedestrian facilities, levels of non-motorized transport (NMT) have begun to fall sharply in many of Asia’s cities. In consequence, there has been a dramatic increase in the number of pedestrian fatalities and accidents. High levels of air pollution and poor health have been another unwanted cost of vehicle-centric urban development. Lower levels of physical activity have been yet a third undesirable side effect. The solution to many of these problems is increasing or retaining levels of walking. This solution is particularly relevant to Indonesia. Studies shows that Indonesia has some of the lowest ‘activity levels’ among a sample of 46 countries (T.Althoff et al, 2017). Many policymakers have tried to increase activity levels by focusing attention on improving or building sidewalks that encourage walking. Cities such as Surabaya, Bandung, Bogor and Jakarta have each made improving pedestrian facilities a priority. All four cities have spent time and resources to create safe and attractive pedestrian environments (Saelens and Handy, 2008). In Bandung, the city government has sought to improve pedestrian walkways to build a more liveable city while simultaneously reducing air pollution and mitigating climate change. In Bogor, the city government has sought to improve green pedestrian facilities to improve the NMT while simultaneously increasing access to public transport and recreation and tourism facilities that complement famed urban architecture and botanical gardens.

Bandung's pedestrian environment improvement program is known as "Panca Trotoar". Panca Trotoar" focuses on four main goals and related activities: 1) revitalize sidewalks; 2) develop new pedestrian walkways; 3) increase pedestrian safety; and 4) improve the visual appeal of sidewalks. The program aims to achieve these objectives by ensuring all sidewalks have a bench for resting; a stone ball to prevent traffic on the sidewalk; a flower pot for decoration; a garbage can for cleanliness; and public street lighting for safety. The program is being partially or fully implemented in several parts of the city. The city government of Bogor revitalized pedestrian along the botanical garden to make the city more walkable. The city used an approach named "Dialogue Between Spaces" that combines three major components: 1) green building/urban heritage (national buildings such as: summer palace, colonial buildings, etc); urban green space (botanical garden) and green transportation to ensure all sidewalks could be used not only to support transport system but also support tourism development.

Several questions arise that may help shape the program in Bandung and Bogor that have relevance for other cities in rapidly motorizing Asia. These include the following:

- What are the main factors encouraging and discouraging walking?
- How aware are residents of pedestrianisation program in their cities?
- Has the program changed the willingness to walk?

The article employs two methods to answer these questions. First, it draws upon responses to a survey and analytical hierarchy process (AHP) to rank possible barriers to walking. The results of the AHP reveal that safety and security rank highest among six potentially influential factors (the other factors were feasibility, accessibility (time spent), comfort and pleasure). This result contrasts studies in other cities that suggest feasibility and accessibility rank highest. The article then employs an ordered logit model to assess how improvements to the pedestrian environments may influence willingness to walk longer distances for both walkers and non-walkers. The logit model shows that older and more educated respondents were willing to walk further, while respondents who walk shorter distances were unlikely to change that behaviour. The model also highlights notable interactions between some variables, for instance, showing that female vehicle owners were less inclined to walk further even with improvements to the pedestrian environment.

The remainder of the article is divided into four sections. The next section reviews literature on walking behavior and develops a framework to analyze the variables influencing the willingness to walk in Bandung. A third section describes the study location and provides a quantitative analysis of those factors in Bandung. A fourth section presents the main results. A final section concludes with a discussion of areas for future research.

2. LITERATURE REVIEW

2.1 Conceptual Framework on Walking Behavior

The need for well-designed pedestrianization programs has given rise to a strong interest in walking among researchers and policymakers (e.g., Park et al., 2014). For researchers, much of the work has focused on environmental attributes that contribute to environmentally friendly pedestrian environments. These studies can be further divided into those employing a meso- or micro-level perspective. The meso-level research typically concentrates on aggregated groups of environmental factors that make up a given area's walkability. The list of these factors can include housing density, land use diversity, street patterns, accessibility to a destination, and distance to transit (Cervero and Kockelman, 1997; Cervero et al., 2009). In contrast, the micro-level research concentrates on street-level attributes such as the presence of trees, width of sidewalks, and quality of streets (e.g., Ewing and Handy, 2009). These micro-level attributes can be assessed more systematically with quasi-measurable indicators such as pedestrian signal coverage, curb-to-curb roadway, width of sidewalks, and number of lanes (Park et al., 2014). However, quantitative evidence, especially in evaluating pedestrianization projects in developing cities, is still rather limited (Park, 2008). Such evidence would be particularly valuable in a rapidly motorizing city that is aiming to improve its walking environment such as Bandung and Bogor.

One of the keys to improving the performance pedestrian programs is understanding factors that encourage people to walk. Put differently, it may be possible to analyze factors influencing the decision to walk by examining the relative importance of barriers to walking. Among possible contributing factors are the environmental and social variables listed in Figure 1. The hierarchy of walking was analyzed against a list of possible environmental factors that can influence the decision to walk or not walk (Alfonso, 2005).

The factors can then organized into a hierarchy (inspired by Maslow's hierarchy of needs and theory of motivation (1954)). Previous studies divides these factors into five main groups, namely: feasibility, accessibility, safety, comfort and pleasurability (Alfonso, 2005).

1. Feasibility involves the practicality or viability of walking as a means to arrive at a desired destination, including time spent, walking distance, and mobility.
2. Accessibility involves the connectivity, quantity, quality of the pedestrian facilities.
3. Safety involves the potential of an injury from traffic accident or being a victim of a crime when walking.
4. Comfort involves the ease of walking, and may be related to sidewalk widths, street benches, and other amenities.
5. Pleasurability involves the enjoyment of the walking experiences and may be related to urban design features, architectural elements (Figure 1).

This study's conceptual framework draws upon previous literature on factors that encourage or discourage walking (Figure 1). As shown in Figure 1, the variables that influence walking can grouped into biological, psychological and demographics factors. One such factor is age. Several studies have found older people tend to walk less than younger people (Berrigan & Troiano, 2002; Frank & Pivo, 1994; Ross, 2000). This tendency may due to physical limitations and/or health issues (Alfonso, 2005). A person's age may also influence the feasibility of walking; here again older people may walk less even if they are satisfied with the walking environment. This may be because they fear injury from overexertion (Lee at al, 2013). Other studies suggest age and gender affect walking. In some research, middle-aged men were the least likely to engage in a half hour or more walking per day compared to middle-age women, while younger and older men were more likely than similarly aged women to walk (Helling, A, 2005). Other studies find that women were more likely to walk than men but men walk longer distances and are less concerned with safety issues (Clifton and Livi, 2005). Biological conditions may also influence walking with overweight and obese individuals tending to walk less (Lee et al, 2013). This may because of the additional energy (and calories burnt) needed to walk for heavier segments of the population (J.A. Pintar, et al, 2005).

A related branch of research has looked at the interaction between walking and the built environment. The underlying assumption in many of these studies is that a non-walker may feel that the environment is not conducive to walking and may therefore opt for another mode of transport. On the other hand, a walker may perceive the pedestrian environment to be conducive to walking and be more inclined to walk. Therefore, one's perception of the walking environment can have a strong influence on walking behavior (Van dick et al., 2012). Further, research has shown that walking behavior is associated with physical attributes that can influence perceptions of the walking environment (Park et al., 2014). Several pedestrian-related studies also figure out the important factor of built environment on walking behavior (Handy, 2005; Kalakou & Moura, 2014). Different dimensions of built environment could influence the satisfaction with pedestrian facilities in Bangkok (Iamtrakul, 2014). While these factors often have been assessed based on user perceptions, other studies have employed expert ratings for such an evaluation (Kim et al., 2014). It was also found that the built environment can have indirect effects on walking. The household living in walkable environments tend to have fewer vehicles, while the number of vehicles in household can be negatively associated with frequency of walking (Sehatzadeh et al., 2011).

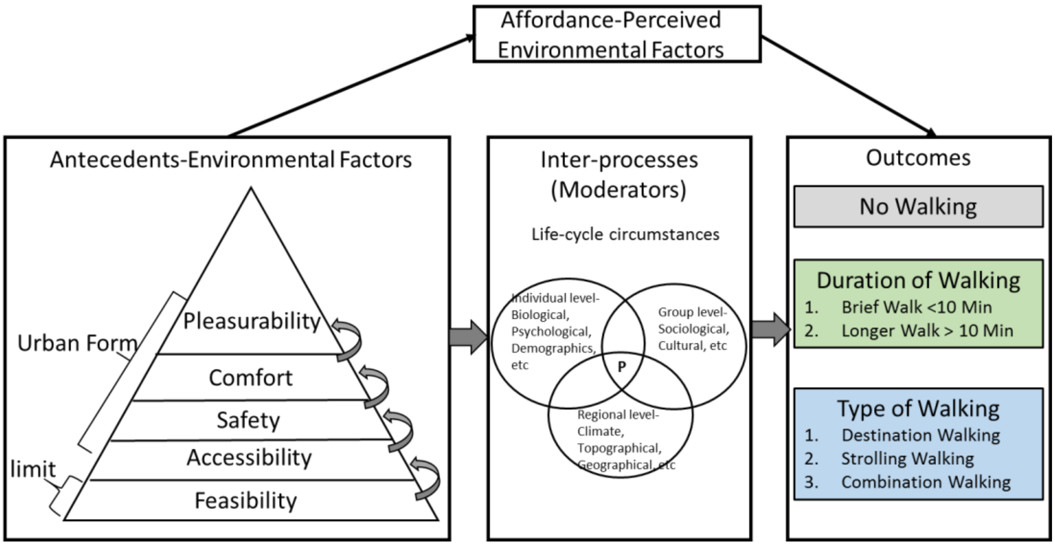

Figure 1. Hierarchy of walking needs within a Social-Ecological Framework (Alfonzo, 2005)

2.2 Quantitative assessment on the impact of pedestrian improvement program on willingness to walk

An ordered logit model is used to identify which factors that influenced the decision to increase reported walking distances following Bandung's pedestrian improvement program. While the above variables mentioned in the previous section were possible independent variables, the outcome of interest or dependent variable was self-reported changes in walking distances after the pedestrian improvement program. More concretely, respondents were presented with the following options to assess their willingness to walk after those improvements: (a) No change (walking distance remains the same); (b) Increase is very short (less than 250 meters); (c) Increase is short (250-500 meters); (d) Increase is modest (500-1000 meters); (e) Increase is significant (1000-2000 meters); (f) Increase is very significant (more than 2000 meters). The information for the relevant variables was gathered from a survey that was administered through a face-to-face interview.

The conceptual model and the survey data were then used to construct an ordered logit model with the functional form as follows:

$$y^* = \boldsymbol{\beta}'\mathbf{x} + \varepsilon, \tag{1}$$

$$Y = \begin{cases} 0 & \text{if } y^* \leq \mu_1, \\ 1 & \text{if } \mu_1 < y^* \leq \mu_2, \\ . & \\ . & \\ N & \text{if } \mu_N < y^* \end{cases} \tag{2}$$

In this model, y^* represents the underlying unobserved responses on changes in walking distance due to the pedestrianization program. The Y is zero if respondent indicates no change in the walking distance. The Y is equal to one if respondents increased their walking distance very little or less than 250 meter. The highest value for Y is five, corresponding to an increase in walking distance more than 2000 meters prior to the pedestrianization program. The β are vectors of parameters, x are independent variables associated with the following (also described above):

1) Respondent's age, sex, education level, and income level
2) Feasibility, accessibility, safety, security, pleasurable, and comfort
3) Body weight, participation in social activities, health

4) Vehicle ownership: motorcycle and car
5) Built environment related to the location of the resident and onsite survey
6) Source of information: understanding about the pedestrian improvement program and source of information

The μ is the threshold value that divides a continuous joint distribution of error terms ε into intervals associated with different walking distances. Further analysis was conducted to compare and evaluate the impact of implementation of pedestrian improvement program for walkers and non-walkers.

3. STUDY LOCATION AND DATA

The data for this study was gathered from Bandung and Bogor, Indonesia. Bandung is the capital of West Java Province, located about 180 kilometers from Jakarta. Bandung's official population reached 2.3 million people in 2010 but more than 5 million people live on Bandung's periurban fringe or surrounding cities. Due in part to rapid urbanization and growing mobility demands, Bandung has been actively seeking alternative modes of transport to supplement its overstretched public transport system and reduce traffic. Bogor is located 60 km from the capital city of Jakarta. It is known not only as the residential areas of many people who work in Jakarta, but also as short tourism destination (botanical garden, summer palace and others) and also educational hub that is home to the country's largest agricultural university. The size of population in Bogor is around half of Bandung while in the day time there are a large number of people who commute to Jakarta on a daily basis.

3.1 Survey

In Bandung, since the micro-level analysis incorporates a smaller unit of measurement, street-level analysis is considered by measuring physical indicators, such as pedestrian signal coverage, curb-to-curb roadway, width of sidewalks, number of lane (see Park et al., 2014). In addition, it is important to bear in mind that the decision to walking is influenced by the walkers interaction with the physical environment. That is, a non-walker may be discouraged by poorly designed pedestrian facilities. In contrast, a good experience may encourage the use of those facilities. Therefore, the physical environment can help predict the walking behavior (Van dick et al., 2012).

Due to the significant data demands, it was not feasible to collect the information needed for a micro-level analysis. But it was feasible to capture other factors by tailoring the design of the study to the local context of Bandung and Bogor. To gather different response from two different groups of Citizen in Bandung, two types of interviews were conducted: home-based interview were conducted with citizens living nearby the areas of pedestrianization program in both Bandung and Bogor. While the on-site interviews were only conducted with non-walker/private vehicle users who visited locations where the "Panca Trotoar" program is being implemented by either car or motorcycle in Bandung city. For non-walkers, the survey explored perceptions of current pedestrian facilities as well as barriers to walking in Bandung city. A baseline for comparison was also set by interviewing a subset of respondents in their homes.

A set of questionnaire was distributed randomly to general citizens in both cities and the private vehicle users in Bandung. The Bandung survey was administered from October-November 2016 for 150 non-walkers and 200 home residents (the overall sample size was 350). The Bogor survey was conducted from January – March 2018 for 600 home residents. The onsite survey for non-walkers was conducted in eight locations where the "Panca Troatoar" program was being implemented in Bandung city. To ensure results were broadly representative of different pedestrian environments, these eight locations were located in parts of the city and with high concentrations of educational institutions, office buildings, recreational areas, and commercial sites. The home based interview survey was carried out in seven locations (see Figure 2) in Bandung city. While in case of Bogor, the questionnaire survey was distributed proportionally to population density at village level in 6 sub-districts within Bogor city. The respondents were selected randomly in each village in Bogor city.

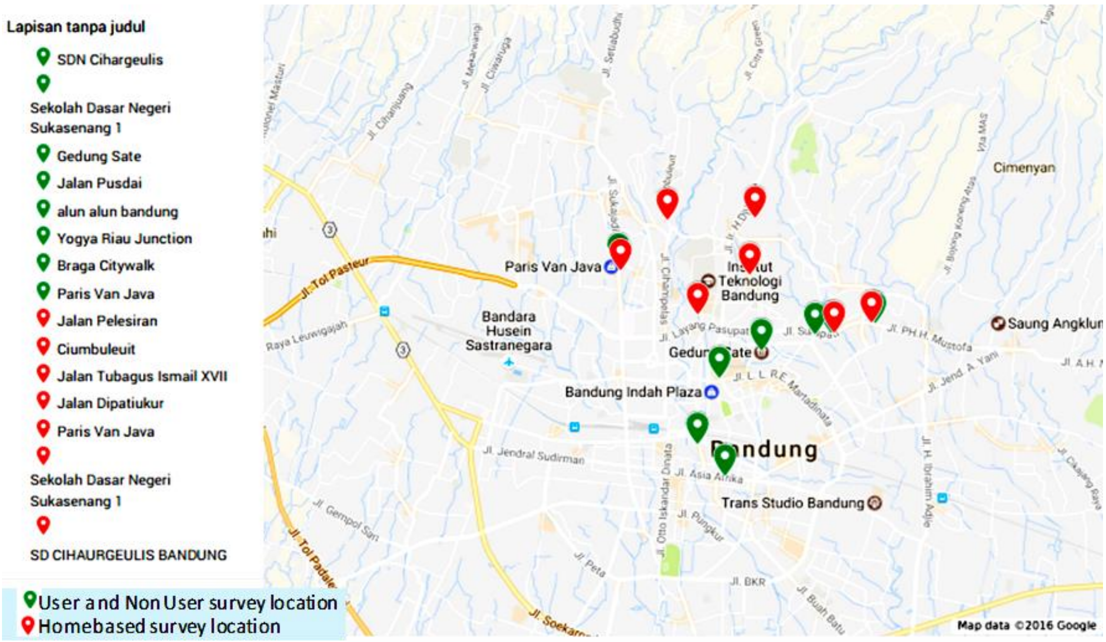

Figure 2 Location of Questionnaire Survey in Bandung

Table 1 Survey Location in Bogor

No	Name of Sub-District	Type of Survey	Number of Samples (N)	Percentage (%)
1	South Bogor	Home Base	119	19.6%
2	East Bogor	Home Base	45	7.4%
3	North Bogor	Home Base	109	17.9%
4	Central Bogor	Home Base	74	12.2%
5	West Bogor	Home Base	136	22.4%
6	Tanah Sereal	Home Base	125	20.6%
	Total Samples		608	100 %

Table 2 Survey Location in Bandung

No	Name of location	Sub-district	Land-use type	Type of Survey
1	SDN Cihargeulis	CibeunyingKaler	Education facility	Non-walker & home base
2	SDN SukaSenang	CibeunyingKidul	Education facility	Non-walker & home base
3	Gedung Sate	Coblong	Public Office	Non-walker
4	Pusdai Bandung	CibeunyingKaler	Public Office	Non-walker
5	Alun-Alun	Regol	Commercial and Business	Non-walker
6	Riau Junction	Bandung Wetan	Commercial and Business	Non-walker
7	Braga City Walk	Sumur Bandung	Commercial and business	Non-walker
8	Paris Van Java	Sukajadi	Commercial and business	Non-walker & home base
9	Plesiran	Bandung Wetan	Residential Areas	Home base
10	Ciumbuleuit	Cidadap	Residential Areas	Home base
11	Dago Tubagus Ismail	Coblong	Residential Areas	Home base
12	DipatiUkur	Coblong	Residential Areas	Home base

3.2 General Information about Respondents

The following descriptive statistics characterized the sample. Around 52.9% of the survey respondents were female; this is consistent with the 49.5% figure reported in official data of Bandung city (BPS, 2015). While in Bogor, it was almost equal between male and female, male respondents around 50.8% and female respondents about 49.2%. In Bandung, most of the respondents were between 17-55 years old without a college degree. In contrast, the home survey in Bogor captured the average age of respondent is 46.6 years old and hold a college degree (53.6%). The largest group of respondents had monthly income around three million rupiah per month. In Bogor, the largest group (31%) had monthly income around 7.6-10 million rupiah per month and most of them (71.5%) had income lower than 10 million rupiah. Most of respondents in both cities owned at least one motorcycle, while very few did not own a private vehicle in Bandung (22.6%) and Bogor (3.6%) (Table 2). In case of Bogor city, the largest group of respondents had combination of motorcycle and car (41.6%).

One quarter of respondents belonged to a social network and/or participated in neighborhood activities; about 37% of respondents did not belong to a network and/or participate in such activities in Bandung city. While in Bogor, more than seventy five percent of respondents have access to internet and 98% use mobile phone to access internet. Therefore, respondents who received information about the pedestrian program in Bogor case around 86% and it is slightly higher than Bandung (60%). Most respondents indicated that this information about the program was transmitted through social media, while some respondents learned of the program through colleagues and/or friend at the office or place of work. A leaflet/booklet or other paper-based source of information was another way respondents learned of the program. Most respondents in Bandung weighed between 50 and 75 kilograms (Table 2).

3.3 Walking and the impact of pedestrianization in Bandung and Bogor

Prior to the improvement of pedestrian facilities, the average acceptable walking distance of the typical citizen in Bandung was about 1447 meters per day and about 1678 meter in Bogor city. For specific group such as non-walkers and private vehicle users were less willing to walk an average of 1297 meters per day in Bandung. For those respondents who relied on non-motorized transport, the average walking distance increased to 2312 meters after “Panca Trotoar”; this is 860 meters per day above the distance indicated prior to the pedestrianization program in Bandung. This result is more than double the amount of the non-walker group or about 424 meter per day. Private vehicle owners indicated that they were willing to walk a slightly shorter 1721 meters. These results indicates the improvement program had a clear impact on the walking distance in Bandung (see Figure 3). The program also gave similar impact in Bogor however it is minor impact. Residents willing to walk a slightly longer at 1861 meter per day or increase around 10.9% of the walking distance. However, most of respondents or around 68.3% didn’t increase their walking distance (Figure 4). Looking at the impact of program by different respondents in Bandung city, most of private vehicle were willing to increase the distance they were willing to walk less than 500 meter. While the general citizen were willing to increase their walking distance a longer distance in Bandung (Figure 4). The ordered logit model can help explain how much of the previously discussed factors contributed to the changes in distances in the pedestrian improvement program.

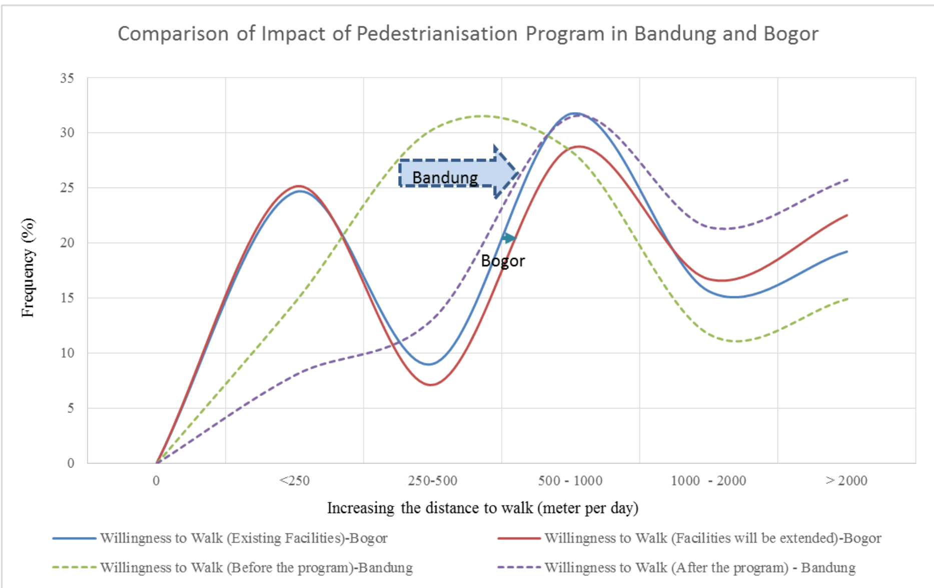

Figure 3. Comparison of walking behavior in Bandung and Bogor city

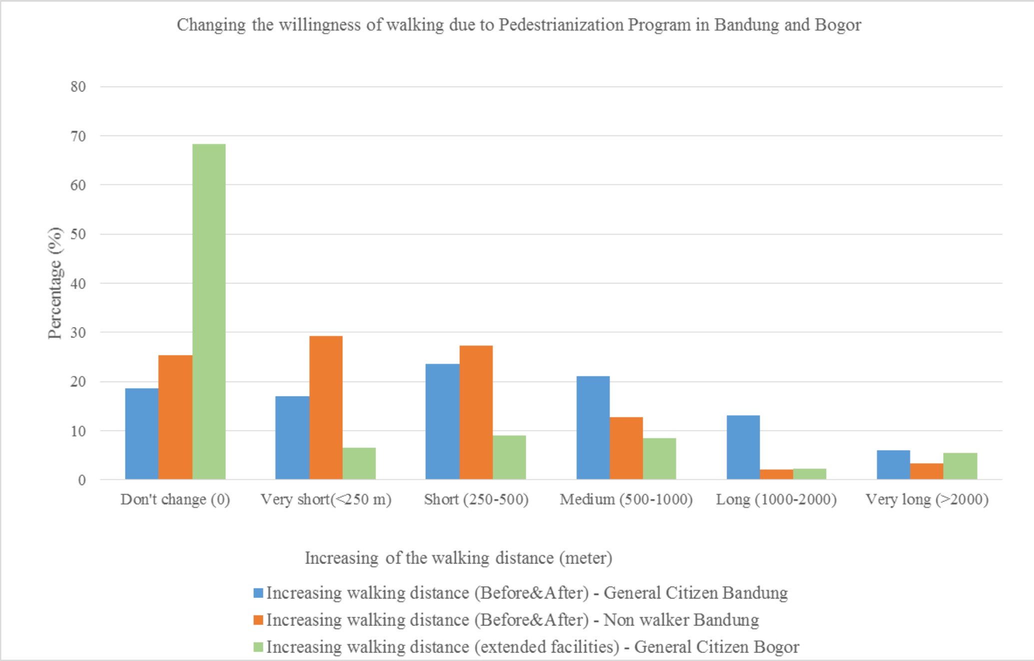

Figure 4. Changing the walking behavior among different group of respondents in Bandung and Bogor

Table 3: Socio-Demographic & Lifestyle Characteristics of Respondents

Category		Bandung (N=350)	Bogor (N=607)
Gender	Male	47.1%	50.8%
	Female	52.9%	49.2%
Age	Below 17	9.2%	0.0%
	17-35	52.1%	17.1%
	35-55	29.5%	62.6%
	>55	9.2%	20.3%
Education level	Postgraduate	4.3%	6.3%
	Graduate from university or college	23.4%	53.6%
	High school or lower than undergraduate student	72.3%	40.1%
Household Income	Less than 1 million rupiah	30.0%	3.3%
	1-3 million rupiah	40.9%	
	3-5 million rupiah	16.9%	18 %
	Greater than 5 million rupiah	12.3%	78.6%
Vehicle ownership	Motorcycle owner	59.4%	40.8%
	Private Car Owner	18.0%	13.8%
	Combination of Motorcycle and Car	n/a	41.8%
	Non-owner	22.6%	3.6%
Body weight (kg)	Less than 50	31.4%	n/a
	50-75	61.1%	n/a
	Over 75	7.4%	n/a
Participation on social activities	Active participate	25.4%	n/a
	Never participate	37.1%	n/a
Understanding about the pedestrian program	Understood/know the pedestrian improvement program by municipal government	60%	87.1%
Source of information on the program	Social Media	30.0 %	23.8%
	Verbal information	19.4 %	16.4%
	Paper based information	19.1%	20.1%

Source: Household Interview Survey; n/a: not observed

4. RESULTS AND DISCUSSION

4.1 Perceive evaluation on promoting non-motorized transport in Bandung

4.1.1 Analytical Hierarchy Process (AHP)

To remove the barriers to walking, a hierarchy of walking needs is constructed. The respondents were asked to give their view on the six factors mentioned previously: feasibility, accessibility, safety, security, comfort and pleasure. Each of respondents were assumed to be a walker and have experiences on walking in pedestrian network in Bandung city. The relative importance of each of these aspects was then evaluated with AHP in a pairwise comparison among the six factors.

The AHP decomposes a decision into a hierarchy of criteria, sub-criteria, attributes, and alternatives through a set of weights that reflect relative importance of alternatives (Berritella, 2007). The application of AHP can arrive at a more balanced set of outcomes when assessing conflicting criteria compared to traditional economic evaluation methods (Tabucanon and Lee, 1995). Therefore, AHP has been widely applied in transport studies. For example, AHP was used to evaluate bridge improvement programs in the United States (Saito, 1987); public transport alternatives (Tracz, 1993); transit privatization project in the United States (Khasnabis, 1994); and rail networks in Istanbul, Turkey (Gercek, 2004).

Although the AHP has been useful in evaluating transportation projects, its application in NMT studies in cities in developing countries is limited. This could be because policymakers have a difficult time gathering data for these decisions. The hierarchical structure and the use of additive compositional rule may also reduce the degree of accountability of AHP. This is possible due to the large number of decision elements from various stakeholders who have different priority and target that could prevent decision makers from understanding the links between their preferences and results.

4.1.2 Perceive evaluation on walking needs in Bandung

Previous studies (Alfonso, 2005) found feasibility (e.g., mobility, time limitation) was the main determinant in influencing the decision to walk. Simply stated, people will not walk if they do not have enough time to reach their destination. In the case of Bandung, however, safety and security was a greater need than feasibility. Meanwhile, feasibility fell in the middle of the hierarchy with comfort. Pleasure was the least important factor similar to previous studies. These results might reflect the low levels of pedestrian safety and security in Indonesia. (Alfonzo, 2005).

Table 4. Weighting barriers to walking in Bandung

Antecedents - Environmental Factors	Relative Weight
Pleasure	0.09
Accessibility	0.13
Feasibility	0.14
Comfort	0.16
Security	0.21
Safety	0.27

In the interviews with non-walker/private vehicle users, to make the list of factors easier for respondents to understand, weather, air pollution and pedestrian facilities replaced pleasure, comfort and accessibility. However, the results were similar; safety and security along with weather received the highest relative weight at 0.19. Comfort and pedestrian facilities received a score of 0.17 and 0.15. Meanwhile, feasibility in terms of travel time and travel distance together with air pollution weighed the least in the decision to walk or not.

4.1.3 Perceive evaluation on pedestrian facilities in Bogor

In the interviews with resident in Bogor, most of respondents says that pedestrian facilities is safe (84.3%), convenience and comfortable (96.5%) for walking in the city. The other study also reported that pedestrian facilities are available and there is no obstacle/barrier although it is not convenience for elderly and disable person (N, Tanan, 2017). The respondents had experience to use pedestrian facilities for sport activities (63.5%) and leisure activities (57.3%), however, only few of respondent use it for commuting trip (3.3%). The respondents also expect that pedestrian facilities will be extended (89.6%); connected with transport urban facilities such as bus or train station; shopping mall etc (90.8%). They also expect that pedestrian facilities could be covered by canopy to protect them from rainfall and sunshine (61.5%). By conducting household interview survey, we could also observed that in case of pedestrian facilities are expanded, then around 81.9% of respondents willing to use for non-commuting trip such as: lunch, recreation/leisure and shopping activities.

4.2 Evaluation on Walking Behaviour in Bandung and Bogor

The dependent variable is change in walking distance based upon the previously described intervals. The independent variables were divided into 1) personal attributes; 2) socioeconomic background; 3) lifecycle circumstances; 4) lifestyle circumstances; 5) regional level attribute for land-use type: residential areas and others; 6) the six environmental factors mentioned previously; and 7) interactions between several factors such as gender, vehicle ownership and environmental variables. The estimation was calculated with the econometric software LIMDEP (NLOGIT) (Greene, 2002). A comparison was made between general citizens and non-walkers and the estimation results are shown in Table 5. The table only shows statistically and substantively significant variables from the model.

The modelling results suggest the following. Age of respondent tended to increase post-program walking distances in both Bandung and Bogor. Well-educated people were more willing to increase their walking distance with upgrades in pedestrian facilities in Bandung. In contrast, for the group of people who walked very little, the improvement program actually had a negative influence on reported walking distances in both cities. For respondents who walk a very short distance per day (less than 300 meter per day), pedestrian program did not appear to increase--and may even reduce--their willingness to walk further distances. This suggests that the pedestrian improvement is not appealing enough to those who walk short distances to extend those distances. Though it is difficult to say why this is the case, the apparent unwillingness to be persuaded by new facilities is consistent with the studies showing that Indonesia has the lowest ‘activity levels’ among 46 countries (T.Althoff, 2017). The influence of the above variables are consistent in term of sign and statistically significant across cities and general citizen and non-walker groups in Bandung. However, some variables had a partial influence on certain groups of respondents. For example, the ownership of motorcycle was correlated positively with an increasing walking distance for the typical citizen in Bandung. This is probably related to a sense that even motorbikes are struggling to make it through increasingly dense traffic and walking could be quicker and healthier. A related finding was the positive and significant role that gender played in the group of non-walkers or private vehicle users. Women tended to have a more positive view on walking compared to male respondents in Bogor and non-walkers or private vehicle users in Bandung. This is consistent with previous studies that find women are more likely to walk than men, but men generally walk longer distances than women. (Clifton and Livi, 2005). In contrast, high-income respondents (more than 5 million rupiah per month) and people with health problems were unwilling to increase their walking distance in Bandung. A somewhat counter-intuitive finding was that respondents weighing more than 75 kilogram were willing to increase their walking distance in Bandung. This result corresponds with literature on “activity inequality,” suggesting that walking habits are closely related to weight (T. Althoff, et al, 2017) and pedestrian facilities may increase motivation to lose weight by walking. From a behavioral standpoint, the more enjoyable the exercise experience, the more likely people are to engage in that activity (Dishman et al, 1985).

The model also successfully captures some unobserved effects that become more visible by looking at the interactions between different variables in a certain place. For instance, perceptions of feasibility (arriving at a destination on time) has a positive impact when it is interacted with car ownership in Bandung. This suggests that time and travel distance is important for a car owner. Another interesting result involves the interaction between non-walkers and motorcycle owners. Although motorcycle owners who attach importance to the pleasure from walking were inclined to walk further, female respondent in this group reported the opposite. A similar situation was also observed for motorcycle owners who place a premium on comfort; respondents with these characteristics negatively influence walking behavior, but the opposite effect was found for women. These results suggest the important mediating role of gender on walking for non-walkers and/or private vehicle users. However, it should also be highlighted, that these findings might be context specific as they were not found in Bogor.

Looking at the level of increasing walking distance due to the improvement of pedestrian facilities in Bandung and Bogor, the ordered logit model can help simulate the actual decision to walk. The threshold values (μ) that divide a continuous joint distribution of error terms ε into intervals help to identify different walking distances. As for the typical resident, all estimated constants and μ are positive. This suggests that there was a substantial increase in walking distances due to the pedestrian improvement program. The μ (1) represents the threshold parameter between group Y=0 and Y=1; the constant represent the threshold parameter between Y=1 and Y=2; μ (2) represents the threshold parameter between Y=2 and Y=3; μ (3) represents the threshold parameter between Y= 3 and 4; and μ (3) represents the threshold parameter between Y= 4 and 5. In contrast, for the respondents in Bogor and non-walkers in Bandung, the constant of estimation is negative. This suggests that around 68% of Bogor's citizen and 25% of Bandung's respondents do not want to change their walking distance (Figure 4). However, the other remaining estimation results of threshold parameter are positive and significant, suggesting a willingness to increase walking behavior for much of the sample.

Based on the assessment of estimation result, willingness to increase walking distance due to the pedestrian improvement program in Bandung and Bogor could be an ordered process from do not change (walking distance remains the same) to short distance (less than 250 meters) to medium distance (500-1000 meters), culminating with very long distance (more than 2000 meter). However, the magnitude scale of additional walking distance is modest in Bogor.

Table 5. Estimation Results of Ordered Logit Model in Bandung City and Bogor City

No	Variable	General Citizen (Bandung)		Non-walker (Bandung)		General Citizen (Bogor)	
		Estimated parameter	*t-statistic*	*Estimated parameter*	*t-statistic*	*Estimated parameter*	*t-statistic*
1	Constant	1.856***	3.868	-1.152*	-1.698	-1.666***	-3.590
	Observed variables						
2	Age	0.186*	1.863	0.427***	2.981	0.133**	2.324
3	Female	-	-	0.895**	2.359	0.808***	3.054
4	High Income (> 5 million rupiah)	-0.388*	-1.632	-	-	-	-
5	Education Level	0.313**	2.013	0.810***	3.413	-	-
6	People who walked very little (less than 250 m per day)	-1.136***	-4.753	-0.658**	-2.063	-0.238*	-1.662
7	Ownership of Motorcycle	0.772*	1.675	-	-	-	-
8	Body weight over 75 kg	-	-	0.916**	1.968	n/a	n/a
9	Have health issue/problem	-0.376*	-1.871	n/a	n/a	n/a	n/a
	Interaction Effects (unobserved variables)						
10	Hear the pedestrian program via Paper based information (newspaper, bulletin, leaflet etc)	-0.480**	-2.150	-	-	-0.280**	-2.323
11	Ownership of Car & Perceive evaluation on feasibility aspects	1.612**	2.131	-	-	-	-

12	Motorcycle Owner & perceived evaluation on comfort aspects	-	-	-0.251***	-3.331	-	-
13	Motorcycle Owner & perceive evaluation on pleasure aspects	-	-	1.707**	2.292	-	-
14	Female owner of motorcycle and perceived evaluation on comfort aspects	-	-	1.208**	2.354	-	-
15	Female owner of motorcycle and perceive evaluation on pleasure aspects	-	-	-1.244**	-2.482	-	-
	Threshold Parameter for Index (μ)						
	$\mu_{(1)}$:	1.694***	15.512	0.985***	9.179	0.216***	6.204
	$\mu_{(2)}$:	2.265***	23.568	1.980***	14.870	0.586***	10.255
	$\mu_{(3)}$:	2.983***	30.502	2.775***	15.172	1.112***	12.950
	$\mu_{(4)}$:	3.757***	31.139	3.009***	14.187	1.335***	13.097
	Model's attributes						
	Degree of Freedom	26		25		12	
	AIC	3.290		3.088		2.109	
	BIC	3.802		3.690		2.249	
	Mc Fadden Pseudo R-squared:	0.093		0.113		0.035	

Note: ***: significant at 99% (1 %); **: significant 95% (5 %) ; *: significant 90% (10%); n/a: Data is not observed

5. CONCLUSION

This article analyse the factors of a recent municipal government program to improve pedestrian facilities known as "Panca Trotoar" and "Walkable Bogor City" its influence on walking behavior in Bandung and Bogor City. These pedestrian improvement programs are designed to ensure the sidewalks are equipped with several amenities and is being gradually implemented throughout the city. The article answers several questions related to the implementation of the program in Bandung and Bogor city.

To answer these questions, a survey was distributed to understand preferences for walking environment. The next step, an ordered logit model, was applied to quantitatively analyze factors affecting walking behavior. Individual attribute age of respondents tended to increase walking distance. In contrast, changes to walking behavior were negligible for people who walked very little (less than 250 meter per day). While the effect of the two aforementioned variables were consistent across cities and group of respondents, some variables influenced certain place and group differently; for example, motorcycle ownership had a positive influence on increasing walking distance for general citizen in Bandung. Meanwhile, wealthy and unhealthy people did not to increase their walking distance in Bandung. Further, gender also played an important role to improve walking behavior of non-walker group or private vehicle user in Bandung and general citizen in Bogor city. The model also capture interactions such as the link between gender and vehicle ownership.

The results of the study could provide feedback to city government in order to improve the pedestrianization program in Bandung city; Bogor city and other cities in Indonesia and Asia. But while the study uncovered several interesting findings, it was not free from limitations. For example, self-reported measures of walking distance may include bias and reliability issue of analysis results because it was based on information given by respondents; there is a need for actual measurement. Further, the sample size is rather small and may be increased to capture more parts of the city as the pedestrian program expands.

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