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CAUSES OF DIFFERENCES IN PEDESTRIAN CHARACTERISTICS

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CAUSES OF DIFFERENCES IN PEDESTRIAN CHARACTERISTICS

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7. Abstract

Pedestrian infrastructure is an important part of the urban fabric. It is a responsibility of urban and transport planners to provide safe and user oriented facilities to cater for walking. The work presented in this book aims to show that there is much to be learned from potential users of pedestrian infrastructure, at the local level.

From a technical point of view, research work covered in this book has investigated the relevance of regional characteristics and pedestrian behavioral characteristics as set out in the conceptual framework shown in Figure 2.1. Regional characteristics considered here were separated to three categories as, (1) environmental attributes (2) properties of urban infrastructure and (3) sociological consideration of the regions. Surveys conducted and analyses performed during this project have revealed the presence of regional influences on pedestrian characteristics. Chapter 4 has provided a detailed comparison of different attitude statements posed to survey respondents in different countries and cities. The spread of scores provided by respondents from different regions enabled the research team to focus on connections between regional properties and particular characteristics related to pedestrian mobility.

8. Key Words

Pedestrian Attitude; Pedestrian Behavior; Climate; Stage of Life; Lifestyle

Table of Contents

Preface

What made the study team challenge the issue walking behavior? Walking has been a basic building block in transport systems for a long time during the human evolution. In spite of the apparent reduction in attention to this field at recent times, this is still an important topic in our efforts to orient community environment toward ecological sustainability and low carbon emission targets. The study team has considered that planning and development of appropriate pedestrian infrastructure will remain an important societal need.

We observed that the conventional understanding of pedestrian behavior was simplistic as there was an assumption that this phenomenon was of similar character across different cities and countries. We could not agree this as a valid basis for planning pedestrian infrastructure. Thus, the main intention of our team is to demonstrate that there are similarities and dissimilarities of pedestrian behavior among different cities in East Asia. We document here the technical methods followed to better understand this phenomenon.

It is reasonably easy to show that pedestrian attitudes and behavior are different in different cities. What courses such differences? We believe that regional characteristics of the particular city influence pedestrian attitudes and behavior. There is a cyclic interrelationship here as pedestrian characteristics partly define lifestyle patterns of locals in that region. The study team has explored number of analytical methods suitable to investigate relevant relationships. These studies were conducted over nine year and involved field surveys in 22 cities spread over four countries.

We take this opportunity to acknowledge the support and encouragement provided by number of organizations and individuals. The Eastern Asia Society for Transportation Studies (EASTS) has been the primary source of support for this research work. Members of this research team formed an International Research Group in 2005 under an initiative by the International Scientific Committee of EASTS. Authors thank members of the International Scientific Committee and the EASTS secretariat for their assistance. The researchers are particularly thankful to the funding provided by EASTS in the form of ICRA grants in 2009 and 2011 at important stages of this project work. Funding provided for continuing work by the Ministry of Education and Science of Japan in 2011-2013 is also much appreciated. Authors also thank the National Cheng Kung University of Taiwan, Pusan National University and Ministry of Public Works and Transport in Lao PDR for their assistance during workshop activities conducted by the research group at their premises in 2008, 2010 and 2012 respectively. There are many other individuals who assisted us in numerous ways during this long project.

Majority of members of the International Research Group belonged to universities and organizations in Japan, Australia, Taiwan, and South Korea. Much of the content included in this book originated from papers presented by members of this group at the EASTS Conferences in Dalian 2007, Surabaya 2009, Jeju 2011, and Taipei 2013.

Chapter 1. Introduction

Walking as a means of mobility has been important since the beginning of the human history. Today, walking is an unavoidable element in most passenger transport systems. To cater for walking, planners have to provide safe and user oriented pedestrian facilities. Importance of walking has heightened today as we strive to establish low-carbon emission cities to reorient the society toward ecological sustainability.

Pedestrian traffic is a complex phenomenon that should be and could be approached from various fields of academic research. A useful contribution to the multidisciplinary nature of understanding pedestrian activity was provided by Nagayama (1989) who investigated the difference of pedestrian attitudes and behavior in several Japanese cities from the psychological point of view. His work and other researchers who have looked at impacts of gender and ethnicity (for example, Seedat et al., 2006; Lawson and Edwards, 1991) have indicated the need to understand the cultural significance in the context of pedestrian safety. Similarly, a study by Hughes (1988) has documented the influence of regional culture in the context of aesthetics and visual form of pedestrian facilities.

It has been a challenge in this work to include lifestyle elements of pedestrians without probing into personal life. Groundwork for this approach was documented by Sugihara and Tsukaguchi (2005) as well as Hsia and Yeh (2006). Follow up work made observations about attitudes and pedestrian behavior among selected cities in Japan and Taiwan (Tsuakguchi et al., 2007). Addition to these, Tsuakguchi et al. (2009), Tanaka, Y., (2009), Tsuakguchi et al. (2011), Hsia et al. (2011), Tsuakguchi et al. (2013),Tajima et al. (2013), and Hsia et al. (2013) also described details of pedestrian behavior characteristics. Above studies focused on development of a methodology to identify similarities and dissimilarities of attitudes and preferences of pedestrians, as a means of understanding the outlook toward walking in different localities.

There are two main benefits anticipated from the study of regional impacts on pedestrian travel behavior. They are:

(1) A behaviorally meaningful manner of planning for pedestrian spaces and selection of suitable planning standards become possible when specific regional characteristics based on historical, cultural and lifestyle characteristics can be taken into consideration. This would reduce imposing communities to bow to live in conformity to planning practices based on exported standards. In the long-term, the community can develop a greater appreciation of their urban space when the built environment fits natural character of inhabitants.

(2) Planners and decision makers can set targets and priorities that are a close fit to communities they serve. Although they can use concepts handed down from national and international planning agencies, it is necessary to fine tune to local needs. For this to be

successful, planning agencies at higher levels of the hierarchy should provide adequate means and freedom to allow community level fine-tuning. Research is required to uncover the degree of specificity of the pedestrian culture so that appropriate protocols can be introduced to planning and engineering disciplines.

Pedestrian travel behavior is a composite outcome of infrastructure, individual characteristics and societal attributes. For example, awareness of pedestrian environment and attitudes toward walking depends on the lifestyle and outlook of people in a given region. Conversely, this particular mind-set has an effect on pedestrian behavior. Thus, understanding of pedestrian behavior is incomplete without an appreciation of the societal perspective. It is the lifestyle outlook that has been considered as the main element of the regional impact in this study. Sometimes this regional impact is referred as the pedestrian travel culture.

The work covered in this study attempts a quantitative analysis of pedestrians over selected East Asian countries in an attempt to better understand behavioral characteristics of pedestrian activities. This study is based on a framework that accounts for the outlook of residents toward walking in their communities with their particular sociological background. Field surveys were carried out in total of 22 cities in three countries (Japan, Taiwan and South Korea) in the East Asian region and one city outside the region (in Australia) for the comparative analysis performed during this project work.

Chapter 2. Connections between personal behavior and urban environment

The aim of this research project is to provide evidence that regional characteristics impact on pedestrian behavior. What is required is an understanding of these impacts in a manner they can be incorporated in to planning and engineering of pedestrian facilities. This chapter aims to explain the framework adopted for analysis work in this project. This framework is an attempt to identify the main relationships that are explored in detail in later sections.

2.1 The conceptual framework

The term 'regional character' is applied here in a broader sense to include geophysical properties, the nature of the transport infrastructure and socio-cultural aspects of those living in that area. Pedestrian characteristics we are interested here relate to desires and requirements of the public about their pedestrian spaces. Figure 2.1 lists main concepts considered as regional characteristics and pedestrian properties. This figure is a simplified illustration of the connectivity among elements that contribute to the pedestrian behavior as proposed in Tsukaguchi et al. (2007). There are three main elements considered as regional characteristics. They are labelled as (A) regional environment that includes physical attributes of the area, (B) level of service of the urban infrastructure that covers nature of the existing transport system and built environment, and (C) sociological properties of citizens including lifestyle characteristics. Inclusion of sociological properties under regional characteristics allows the regional properties to contain cultural elements of the region as well.

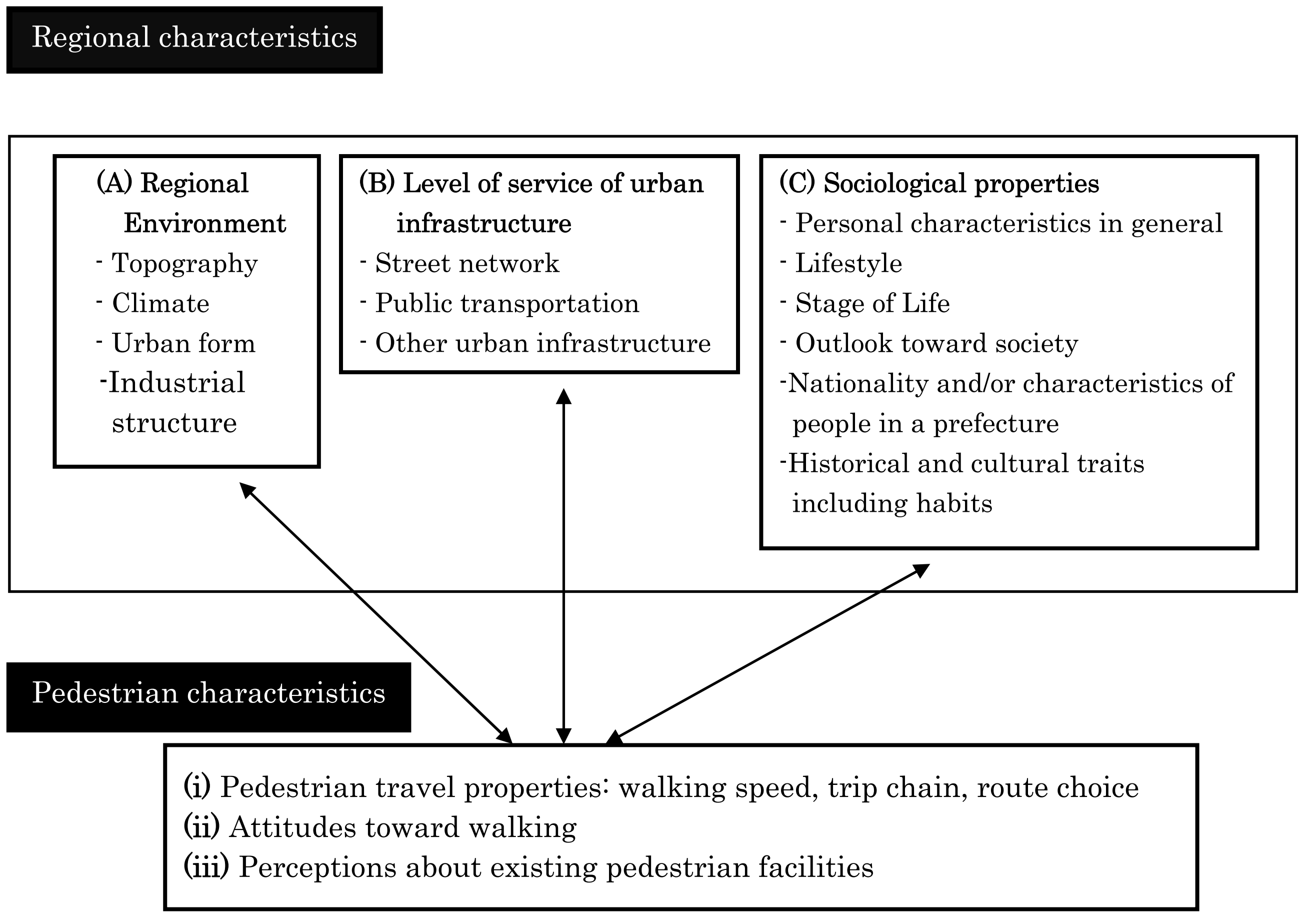


Figure 2-1 Framework developed to discuss impacts of regional properties on pedestrian behavior

There are many possible interrelationships between elements of regional characteristics shown at the upper part of Figure 2-1 and pedestrian characteristics shown in the lower part of the diagram. Pedestrian characteristics include range of attributes useful to transport planning work such as pedestrian travel properties, general attitudes toward walking, and awareness of pedestrian facilities available.

We consider a composite of all of regional and pedestrian characteristics form a concept similar to 'cultural upbringing' to pedestrian behavior. The cultural and regional influence is a result of relationships among these features. These relationships have a two way nature as shown in bidirectional arrows in the diagram. There is a potential for impacts from regional characteristics included in the upper box of the figure to pedestrian characteristics indicated by the lower box, while there are other influences from the lower box to the upper box.

Following chapters will review some of the important relationships using the framework mentioned in Figure 2-1. For example meaningful connections between regional environment identified by label (A) in Figure 2-1 and attitudes toward walking identified by label (ii) are mentioned in Chapter 4. Table 2-1 provides a summary of such linkages that will be presented in future chapters.

Table 2-1 Connections between pedestrian behavior and living environment covered in future chapters

Relationships connecting features below	Short description with relevance to Figure 2-1	See following chapters
• *Regional environment(demographics)* • *Attitudes toward walking*	Link between (A) and (ii)	Chapter 4
• *Regional environment (Specifically climate)* • *Attitudes toward walking*	Link between (A) and (ii)	Chapter 5
• *Regional environment* • *Sociological properties* • *Pedestrian travel properties*	Links among (A), (C) and (i)	Chapter 8
• *Level of service of urban infrastructure (public transportation)* • *Perceptions about existing pedestrian facilities*	Link Between (B) and (iii)	Chapter 10
• *Sociological properties(stage of life)* • *Attitudes toward walking*	Link Between (C) and (ii)	Chapters 6
• *Sociological properties (Lifestyle)* • *Attitudes toward walking*	Link Between (C) and (ii)	Chapters 7

2.2 Measurement of attitudes toward walking

This section provides a brief description of the term attitudes toward walking mentioned number of times in Table 2-1. It was decided to quantify responses of locals to a selected number of attitude statements. For the purpose of surveys that will be explained in the next chapter, it was decided to limit to 10 such statements. Respondents were asked to record their level agreement to following statements. The first four statements are related to willingness to walk, the next four are related to preferences related to pedestrian facilities. The last two statements provide personal reflections of individuals.

(a) I like walking.
(b) Walking is smart.
(c) I am willing to cover short distances by walking in daily life.
(d) I like to walk and stroll.
(e) I prefer a street with good scenery for walking.
(f) I prefer a street with good surroundings (neighborhood), even if a little detour is necessary.
(g) I prefer a busy street, even if a little detour is necessary.

(h) I prefer the shortest route when the surroundings (neighborhood) are not pleasant.
(i) I walk faster than others.
(j) I usually cross a road during a red signal if there is no traffic.

In essence, the objective of the project is to measure variations of responses to above attitude statements in different localities. It is then possible to introduce statistical methods to identify regional characteristics that have strong influence and those properties that has little or no impact on pedestrian behavior. Explorations began with a focus on impacts of regional environment (shown by label A in Figure 2-1). Analysis was then extended to investigate the impact of urban infrastructure including existing level of service of transport facilities (shown by label B in Figure 2-1). Investigation of the influence of level of services of transportation facilities on pedestrian characteristics has been the subject of many conventional research projects. Such works have made useful scientific contribution to the field of pedestrian planning. Anyhow, the analysis related to sociological variables (shown as label C in Figure 2-1) and pedestrian characteristics have been less researched probably because there is a wide range of unknown factors and quantification difficulties that will be explained in later chapters. This study wants to pay particular attention to relationships associated with region specific historical and cultural traits. These investigations will therefore pay attention to habits, lifestyle, way of thinking, and outlook toward interactions within society. Conventional studies on pedestrian travel often avoid such seemingly 'soft' relationships, but this viewpoint is important to create 'pedestrian centric' environment in downtown areas and residential neighborhoods.

The project team explored these issues in a systematic sequence. Firstly, number of surveys was carried out in a particular country and selected relationships were analyzed for variations among different cities. At the second stage, these comparisons included cities from other countries as well. Field surveys were carried out in 22 urban areas in four countries; Japan, Taiwan, South Korea, and Australia as explained in Chapter 3. Chapter 3 begins with a brief explanation of the questionnaire design.

Chapter 3. Survey administration

This chapter describes survey methods and analytical techniques adopted in majority of following chapters. These methods were selected with the aim of investigating linkages between the regional characteristics and pedestrian characteristics as indicated in Figure 2-1. Individual applications presented in later chapters may include some modifications to basic methodology identified in this chapter. Specific details related to different applications are presented in relevant chapters.

3.1 Methodology for data collection

Two different data collection techniques were applied during this project. A questionnaire survey was conducted to explore pedestrian attitudes and preferences in relation to pedestrian space. In addition, observational survey was conducted to obtain supplementary data to quantify pedestrian behavior.

3.1.1 Questionnaire about attitudes and preferences

Questionnaire form shown on the next page has been adopted as base questionnaire form applied in all selected cities spread over different countries. Initially this questionnaire was applied for surveys in Japan and Taiwan. Number of extra questions was added in surveys that followed in South Korea, at the suggestion of the local team to suit Korean conditions. The questionnaire forms were written in native languages Japanese, Chinese and Korean for the respective countries.

The following questionnaire form was developed and administered in surveys carried out in 2004, 2006 and 2008. This questionnaire presumed that age is a sufficient indicator to explain "lifestyle" and "stage of life". Additional questions, particularly in relation to "lifestyle" and "stage of life" were added in later surveys carried out in 2011. The final modified questionnaire is presented later during discussion of associated analysis in Chapter 6.

The two pages of the questionnaire survey form are shown in Figures 3-1 and 3-2. It can be seen that the 10 attitude statements mentioned earlier in section 2-2 corresponds to question 4 of the questionnaire.

Q1 Do you use public transportation more than once a month when you make a trip for commuting or shopping?
1. Yes – Continue to Q2.   2. No – Go to Q4.

Q2 Answer the following questions about access to the nearest bus stop.

Q2-1: How far is it from your home to the nearest bus stop?
1) less than 2 min, 2) 2~5 min, 3) 5~10 min, 4) 10~15 min, 5) 15~20 min, 6) more than 20 min

Q2-2: What do you think about distance to the nearest bus stop?
1) very far, 2) a bit far, 3) moderate, 4) not so far, 5) close

Q2-3: What do you think about environment of the route to the nearest bus stop?
1) very easy to walk, 2) easy to walk, 3) moderate, 4) difficult to walk, 5) very difficult to walk

Q2-4: What is the level of safely of the route you take to the nearest bus stop?
1) very safe, 2) safe, 3) moderate, 4) dangerous, 5) very dangerous

Q2-5: What is the acceptable walking time for you to the nearest bus stop in the current condition?
1) Less than 2 min, 2) 2~5 min, 3) 5~10 min, 4) 10~15 min, 5) 15~20 min, 6) More than 20 min

Q2-6: What is the acceptable walking time for you to the nearest bus stop, if the walking environment is modified?
1) less than 2 min, 2) 2~5 min, 3) 5~10 min, 4) 10~15 min, 5) 15~20 min, 6) more than 20 min

Q3 Answer the following questions about access to the nearest railway station.

Q3-1: What transport mode do you use to the nearest railway station?
1) walk, 2) cycle, 3) motor cycle, 4) car, 5) bus

Q3-2: How long do you need to go from your home to the nearest railway station on foot?
1) less than 2 min, 2) 2~5 min, 3) 5~10 min, 4) 10~15 min, 5) 15~20 min, 6) more than 20 min

Q3-3: What do you think about distance to the nearest bus stop?
1) very far, 2) a bit far, 3) moderate, 4) not so far, 5) close

Q3-4: What do you think about environment of the route to the nearest railway station?
1) easy to walk, 2) easy to walk, 3) moderate, 4) difficult to walk, 5) very difficult to walk

Q3-5: What do you think of the level of safely of the route to the nearest railway station?
1) very safe, 2) safe, 3) moderate, 4) dangerous, 5) very dangerous

Q3-6: What is the acceptable walking time for you to the nearest station on in the current condition?
1) less than 2 min, 2) 2~5 min, 3) 5~10 min, 4) 10~15 min, 5) 15~20 min, 6) more than 20 min

Q3-7: What is the acceptable walking time for you to the nearest railway station, if the walking environment is modified?
1) less than 2 min, 2) 2~5 min, 3) 5~10 min, 4) 10~15 min, 5) 15~20 min, 6) more than 20 min

Figure 3-1 Page 1 of the questionnaire form

Q4 Tick or circle the box to indicate your level of agreement to following statements.

	completely agree	somewhat agree	neutral	somewhat disagree	completely disagree
Example I like swimming		○			
(a) I like walking					
(b) Walking is smart (clever).					
(c) I am willing to walk at least a short distance everyday.					
(d) I like walking during my leisure times.					
(e) I like to walk on roads that have pleasant scenery.					
(f) I like to walk on roads through good neighborehoods even when the distance could be somewhat longer.					
(g) I like to walk on streets where they're other people around even when the distance could be somewhat longer.					
(h) I prefer the shortest route when the neighborhood is not pleasant for walking.					
(i) I think I walk faster than others.					
(j) If there is no traffic, I often cross the road while the pedestrian signal is still red.					

Q5 What is your gender? 1) male 2) female

Q6 How old are you? 1) less than 20 2) 20~29 3) 30~39 4) 40~ 49 5) 50~ 59 6) 60~69 7) 70~79 8) 80~

Q7 What is your occupation? 1) company staff 2) official 3) independent 4) part-time job 5) student 6) housewife 7) others

Q8 Do you have your own car? 1) yes 2) no

Q9 How long have you lived in this city? 1) less than 1year 2) 1~5 years 3) 5~10 years 4) 10~20 years 5) more than 20 years

Q10 Name the city you have lived in the longest period so far? ( )

Q11 Have you been involved in any traffic accident? 1) yes 2) no

If you have comments about pedestrian facilities and walking in general, please write in brief in this box.

Thank you very much for your cooperation

Figure 3-2 Page 2 of the questionnaire form

3.1.2 Observation survey on walking behavior

At the beginning of the project, observation surveys were carried out in 5 cities in Japan using an identical methodology. These surveys were carried out at first in Osaka and Kyoto in 2004. The same methodology was followed again in Tokyo and Fukuoka in 2005; and in Matsuyama in 2007.

These surveys addressed two considerations related to pedestrian behavior: (a) walking speeds during different times of the day and (b) compliance of pedestrian traffic signals. The walking speed was recorded according to gender of pedestrian as well as whether the pedestrian is walking alone or in a group. The observers recorded travel time taken between predetermined marker points from video recordings of the pedestrian activity. Walking speeds for individual pedestrians were then calculated based on these observations.

Observers selected pedestrians randomly and recorded data according to a time of day classification and pedestrian type classification. Data were collected for four time periods during the day. These periods were each two hours long, in the morning (8:00 am to 10:00am), over lunch time (12:00 am to 14:00 pm), in the afternoon (14:00 am to 16:00 pm) and evening (17:00 pm to 19:00 pm, typically when commuters return home). The observers categorized pedestrians into three types considering a mix of gender and group size, as “walking alone, male” “walking alone, female” and “walking in group”.

Pedestrian traffic signal compliance survey was carried out for 50 signal cycles (later see Table 8-3) at selected signalized intersections. The locations selected had clearly marked zebra crossings for pedestrian use. Cycle length of signals at these sites ranged from 110 to 180 seconds. The pedestrian signal has three phases, Green, Flashing Green and Red. For the purpose of this survey any pedestrian who commenced the crossing activity during a pedestrian red signal was considered non-compliant and all others were considered compliant.

3. 2 Selection of cities for the questionnaire survey

3.2.1 Classification of cities in Japan

This section provides a brief explanation of the method adopted for selection of cities to be covered in by the questionnaire surveys. The candidate urban centers were selected from cities in Japan having a population greater than 100,000. There were 227 such cities in 2004. Characteristics of data available to classify or rank these are shown in Table 3-1. Principal component analysis was applied here to eliminate the noise created by variations and correlations among different characteristics. The principal component analysis showed that the three important descriptors to be, (1) Intensity of economic activity (2) land-use properties and (3) age distribution of residents, in that sequence.

Table 3-1 Characteristics of data available for classification of cities

Category	Description of data available types
Population	Population, population density, percentage of people older than 65 years, inflow population, outflow population, daytime population, number in household
Land area	Total land area, inhabitable land area
Economic activity	Number of enterprises in secondary industries, number of enterprises in tertiary industries, products of agriculture, amount of industrial shipments, number of newly constructed houses, number of commercial enterprises
Employment	Employment in primary secondary and tertiary industries; unemployment rate, citizens older than 15 years working or studying within their home city
Living standards	Number of retail stores, number of restaurants, total road length, total length of major roads, total length of minor roads, total length of paved roads, number of retained motor vehicles, number of retained passenger cars per household, number of post offices, number of urban parks

The 227 cities were sorted into seven levels of cities by applying a clustering process using the above three descriptors from demographic data. Level 1 cities were relatively small urban centers. There were 86 of such cities. On the other end Levels 4, 5, 6 and 7 covered large cities with special legislative powers. Tokyo was subject to the ranking done here as there was no doubt that this city has to be included in any survey of significance.

3.2.2 Cities selected for surveys

Now, target cities were selected from each of these categories with the objective of ensuring a large coverage of various islands forming this country. This process is somewhat subjective and the selection of cities was also influences by the familiarity of certain cities to members of the research team. Potential list of cities selected at the end of this step is shown in Table 3-2. However, the research team never got the opportunity to conduct surveys in all those cities. The cities eventually surveyed are highlighted by bold font on the table. The 14 selected provided a representative geographical distribution across Hokkaido, Honshu, Shikoku, and Kyushu provinces. The year when the survey was performed is also indicated on this table. The first set of surveys was carried out in 2004 and the second group was surveyed in 2008.

Table 3-2 Cities surveyed

Category/Level number	Names
Local cities/ Level 1	86 cities, located in rural regions that do not have large cities, or satellite cities in metropolitan areas. Shortlisted: **Urazoe (2008, 2011)**
Major cities/ Level 2	84 cities. Shortlisted: Fukui, Akita, **Kanazawa (2004)**, Yamaguchi, Takamatsu, **Tokushima (2008) , Kumagaya (2008)**, **Ogaki (2008).**
Level 3	43 cities. Shortlisted: **Fukushima (2008)**, **Nagano (2004)**, Niigata, Nara, **Matsuyama (2004, 2011),** Kumamoto.
Special ordinance designated cities/ Level 4	**Kyoto (2004)**, Nagoya
Level 5	**Sendai (2004)**, **Hiroshima (2004)**, **Fukuoka (2004)**, Kitakyushu, Kobe, **Sapporo (2004,2011)** Saitama, Chiba, Kawasaki
Level 6	Yokohama
Level 7	**Osaka (2004,2011)**

Note: Cities shown in bold font were surveyed. The number shown within brackets is the year the survey was administered.

The first set of surveys in 2004 was carried out in Sapporo, Sendai, Tokyo, Nagano, Kanazawa, Kyoto, Osaka, Hiroshima, Matsuyama, and Fukuoka. At this stage, many levels 1 to 3 cities were not considered partly because of their smallness and remoteness. However, the second set of surveys in 2008 included cities in the range levels 1 to 3 and was carried out in Urazoe, Kumagaya, Fukushima, Ogaki, and Tokushima.

These attitudinal surveys were also repeated in Taiwan and in South Korea. The selection of cities for surveys in those countries did not follow a rigorous analysis. The selection was based on practical reasons, mainly proximity to the base of a member of the research team. An attempt was made to select cities that fit into the range of population size encountered in the Japanese surveys whilst selecting cities near the host universities in Taiwan and South Korea to minimize the survey administration cost. In 2006, field surveys were carried out in two cities, Kaoshiung and Tainan in Taiwan. Later in 2008, two more cities, Taichung, and Chiayi, in Taiwan were subject to this survey. Also in 2008 the Korean surveys were conducted in two southern cities, Pusan and Daegu.

Later in 2011 a modified questionnaire survey was carried out in Sapporo, Tokyo, Osaka, Matsuyama, and Urazoe for a second time. This survey contained specific questions related to lifestyle issues. Data collected for these cities were combined with previous data collection where possible. The modified survey was carried out in Sydney, Australia as well in the same year.

The questionnaire sheets used in surveys were written in respective official languages, i.e. in Japanese, Chinese, Korean, and English.

Figure 3-1 shows the location of the cities mentioned above to display geographical spread of the surveys performed during the course of this project work. Results from analyses of these data are described later in Chapters 6 and 7.

3.2.3 Survey administration

There were number of notable differences in survey administration method among countries. In Japan, it was decided to use mail back technique to enable researchers to cover the spread of cities selected within a short period of time. It was also decided to target 1000 residents per city with the expectation of achieving about 20% response rate. Average response rate achieved was approximately 24%. To reduce the postage cost, it was decided to select only 500 residences and send two questionnaire forms to each household with cash on delivery. Addresses of target households were randomly selected from the respective telephone directories.

On the other hand, face to face interview technique was adopted for data collection in Taiwanese cities and Sydney. In Taiwan, trained university students were engaged for this work. In Sydney, one of our research members performed the face to face interviews. Here, road side surveys were conducted at five different sites. An attempt was made to ignore the first four available individuals and approach the next person as a way of introducing randomness to the selection of respondent sample.

In South Korea the questionnaire forms were distributed and collected during classes held for renewal of driver license. It is acknowledged that these differences in the survey administration methods cause different biases to the survey samples.

Table 3-3 shows timing of survey and population data for cities mentioned above. Survey response sample sizes are shown in the last column of the table.

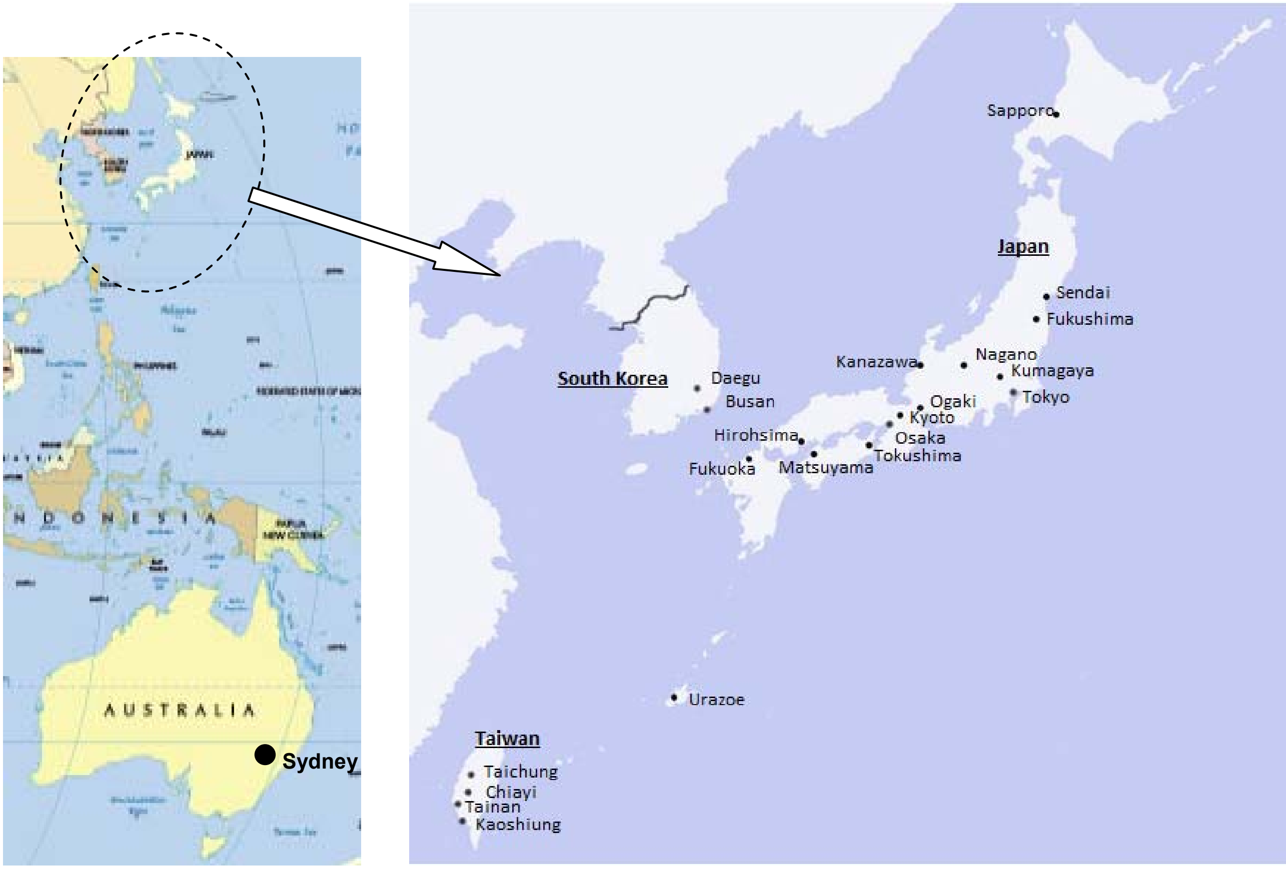


Figure 3-1 Location map of cities covered in data collection

Table 3-3 Numbers of respondents in different East Asian cities

Country	Questionnaire language	City	Population	Stage of survey	Year of survey	Response sample size
Japan	Japanese	Sapporo	1,906,129	First Stage	2004	237
		Sendai	1,037,093			241
		Tokyo	8,502,527			240
		Nagano	387,815			259
		Kanazawa	458,833			194
		Kyoto	1,464,137			243
		Osaka	2,667,817			222
		Hiroshima	1,174,103			216
		Matsuyama	515,857			242
		Fukuoka	1,461,631			275
		Fukushima	293,465	Second Stage	2008	216
		Kumagaya	102,612			256
		Ogaki	164,618			306
		Tokushima	263,806			246
		Urazue	111,595			167
		Osaka (repeated)	2,665,314	Third Stage		205
		Matsuyama (repeated)	517,231		2011	249
		Sapporo (repeated)	1,913545			239
		Urazoe (repeated)	110,351			208
		Tokyo (repeated)	8,945,965			210
Taiwan	Chinese	Kaoshiung	1,525,999	Second Stage	2006	296
		Tainan	772,279			318
		Taichung	1,078,348		2008	300
		Chiayi	274,657			329
South Korea	Korean	Busan	3,523,582		2008	511
		Daegu	2,464,547			401
Australia	English	Sydney	4,605,997	Third Stage	2011	177
Total						5955

Note: (1) Population values in Japanese cities are estimates available for 2010. Population values in Taiwan and South Korea were as reported for 2007 and 2009 respectively.
(2) Osaka, Matsuyama, Sapporo, Urazoe and Tokyo were surveyed again in 2011, focusing on stage of life and lifestyle.
(3) Sydney statistics in this table relates to the greater Sydney area.

3.2.4 Attributes of respondents

The breakdown of respondents according to gender shows that percentages of males and females were 55% and 45%, respectively in Japanese cities. In Taiwanese cities the percentages were 44 % and 56% respectively. In surveys of Korean cities, male percentage was large in Daegu, while female percentage was large in Busan. Approximately equal percentages males and females were observed in the survey sample in Sydney.

Preliminary investigation has shown that there are differences in the age profile of respondent properties in samples from the four countries. This is an outcome of the differences of the sampling techniques mentioned earlier, in the four countries. Age distribution of respondents from Japan contains almost half the sample in age group of above 60 years as shown in Figure 3-3. The below 20 years group was consistently low in the survey samples from Japan. These observations could be considered consistent with the mail back survey technique that relied on the time availability and the goodwill of respondents. Samples from Taiwan, South Korea, and Sydney have a large proportion of respondents in age bands from 20 to 60 years old. Statistical analysis methods will be applied in later chapters to account for these variations of age distribution.

As mentioned in the last section, five Japanese cities (Tokyo, Osaka, Sapporo, Matsuyama, and Urazoe) were surveyed twice, once in the first stage and then in third stage as already shown in Table 3-4. For the purpose of Figures 3-2 and 3-2, the combined data were used for these cities to express characteristics of respondents surveyed. Since gender and age distribution of these samples in the two surveys are almost the same, this treatment may be justifiable.

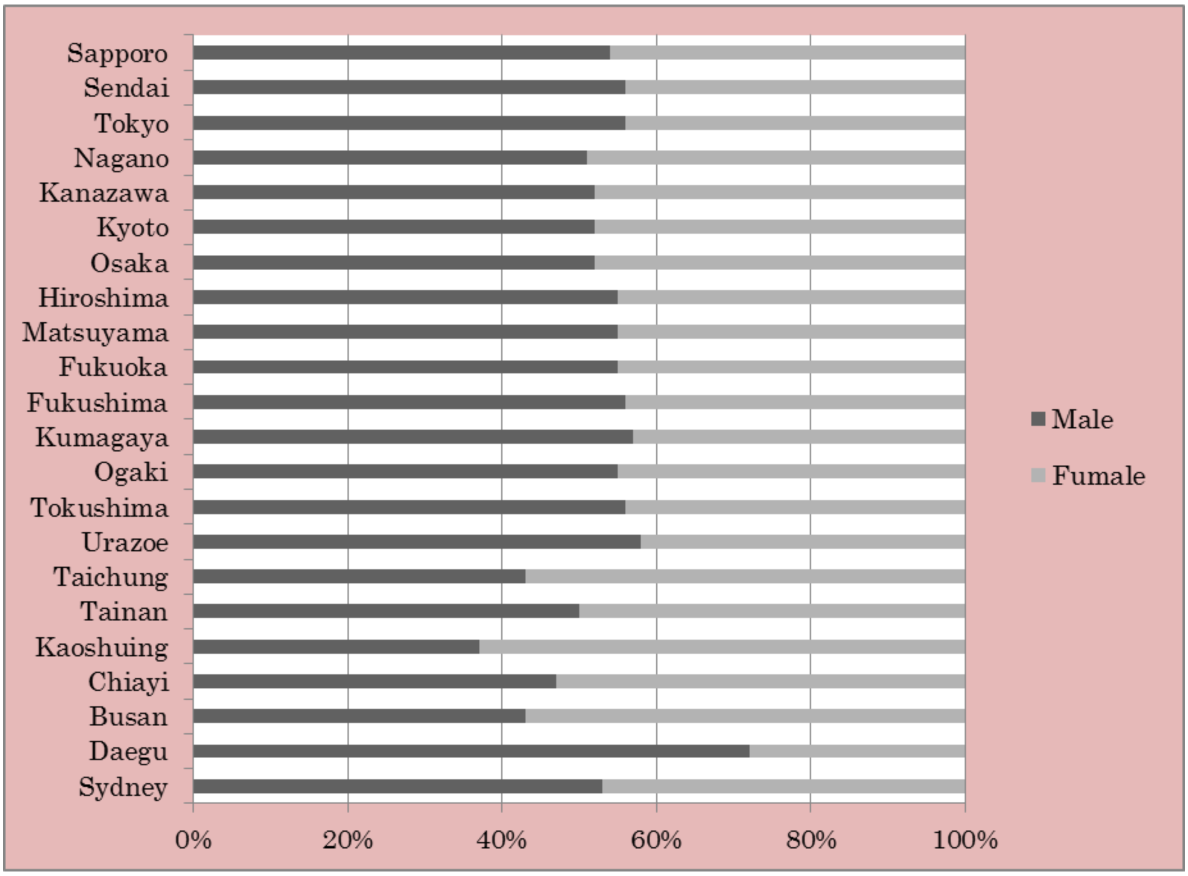


Figure 3-2 Gender distribution of survey samples

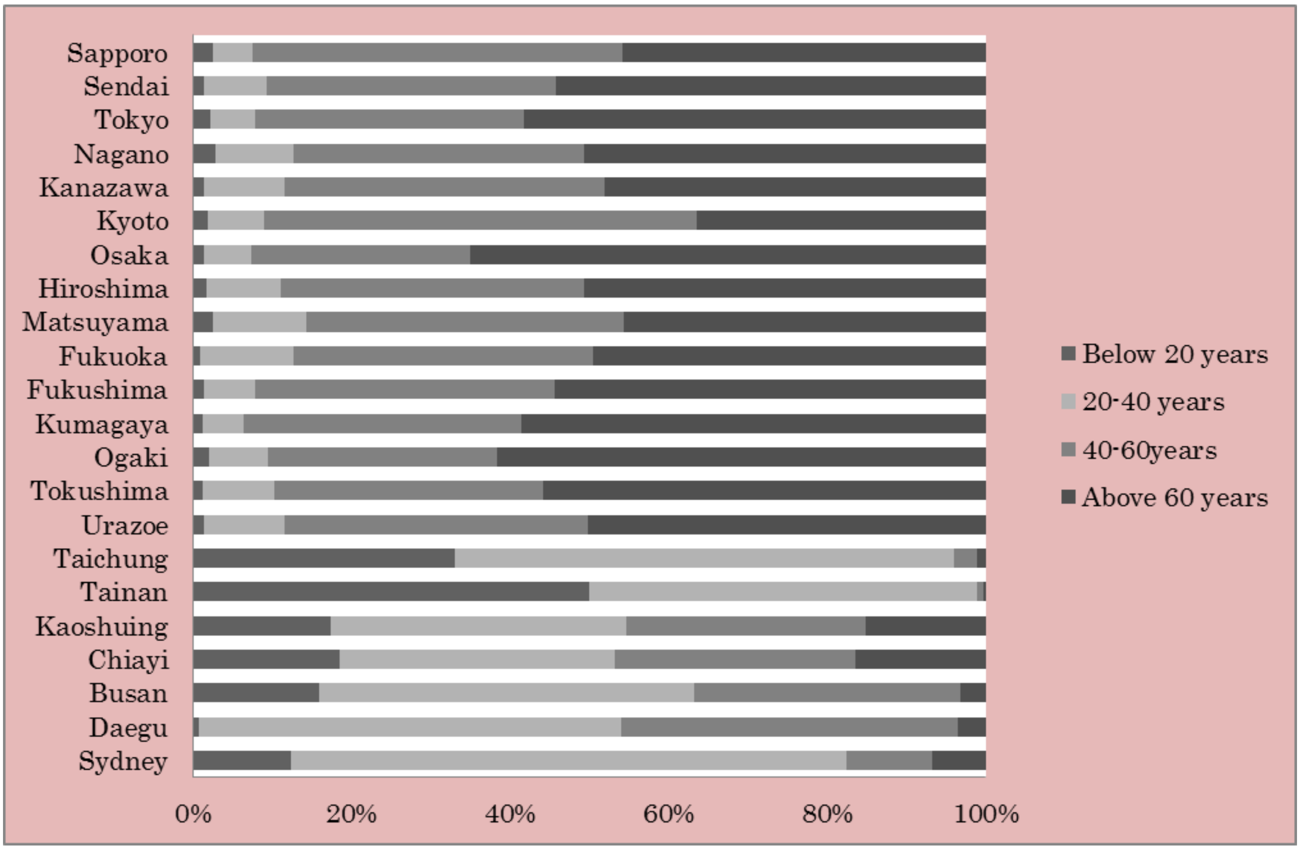


Figure 3-3 Age distribution of survey samples

3.3 Analysis Methodology

3.3.1 Conceptual basis of methodology

The analysis followed a relatively quick method to compare response characteristics from different regions as a graphical presentation of mean values from survey samples. Spider web charts are an effective presentation style for this purpose as shown in the next chapter. However, from a statistical point of view, it is important to account for variability of responses, measured in terms of variance. A standard method is selected where it is possible to determine whether the mean response from one sub-group of the sample is actually different from another sub-group allowing for the spread of response values.

3.3.2 Statistical method

There are two important issues considered in selection of statistical analysis methods suitable for data acquired during this project. The primary objective is to learn whether there is a difference between averages of scores for agreement with statements put forward to respondents.

In particular, it is of interest to know whether a sample of one age group has a higher or lower average score of agreement compared to a sample of another age group. There is another issue related to differences of sample sizes. This study selected a nonparametric analysis method following Kruskal-Wallis method to inspect the statistical significance of differences between level of agreement for pedestrian opinion statements. A particular advantage of the Kruskal-Wallis method is that the data do not have to follow the normal-distribution. However, the method assumes that data in all subgroups follow the same statistical distribution. This method is suitable to perform statistical comparisons where multiple significance tests are necessary to account for different sizes of groupings within the overall sample.

The level of significance estimate has been then corrected using Bonferroni method recommended as a conservative method suitable to handle multiple pairings from a database. Details related to these statistical methods are available in many statistical method text books including Siegel and Castellan (1988) briefly explained as follows:

If the H statistic is greater than the critical Chi-squared value as shown in the equation (1) given below, a significant difference exists between the responses.

$$H(\chi^2) = \frac{h}{1 - \sum_{j=1}^{m} \frac{Tj}{\left(N^3 - N\right)}} \geq \chi^2_{a-1}(\alpha) \qquad (1)$$

When,

$$h = \frac{12}{N(N+1)} \sum_{i=1}^{k} \frac{R_i^2}{n_i} - 3(N+1) \quad ,$$

and

$T_j = t_j^3 - t_j$,

Where,

m : number of attributes in the analysis,

N : total number of respondents,

n_i : number of respondents with a particular attribute i ,

R_i : sum of the ordered data for each attribute i,

t_j : number of samples in the same rank order j, and

α : level of significance.

When a difference is identified, the following estimator in the Bonferroni method (Siegel and Castellan, 1988) leads to the level of significance for the particular comparison.

$$Z = \frac{\left(U - \frac{n_1 n_2}{2}\right)}{\sqrt{\frac{n_1 n_2}{N(N-1)}\left(\frac{N^3 - N}{12} - \sum_i T_i\right)}} \tag{2}$$

Where,

$$T_i = \frac{t^3 - t}{12}$$

and

U : Mann-Whitney's U parameter,

n_1, n_2 : sample size of the pair of groups

SPSS (Statistical Package for Social Science) was used in this calculation.

3.4 Workshops

As this work was carried out with the collaboration of number of researchers scattered in unrelated locations, number of meetings were built into the methodology to realign the processes and verify accuracy of work carried out at different locations. There were many informal meetings and correspondence among researchers. Formal meetings were also organized. In addition, the team organized workshop activities as a way of providing an opportunity to collectively review the research work.

These workshops were one day long activities where team members presented the project to professionals and students with ample opportunities provided for discussions. These activities were promoted with the aim of enhancing motivation and recruitment of young researchers to the area of pedestrian infrastructure planning and development. For members presenting a these occasions, it has been an opportunity to receive feedback and fine tune their research methodology and directions.

The first of these seminars were held in 3 December 2008 at the auditorium of the Department of Urban planning, National Cheng-Kung University, Tainan, Taiwan. The workshop attracted postgraduate students, local government officials and experts from consulting agencies who provided comments into initial surveys and analysis carried out in Japan.

The second such workshop was held in Pusan National University on 4 December 2010. This workshop also attracted postgraduate students and local government officials. In addition, there were a noticeable number of academics from other parts of the country. This workshop also generated many questions and a serious review of different aspects of the research work.

The third workshop was carried out on 10 April 2012 at the conference room in Ministry of Public Works and Transport, in Vientiane, Lao PDR. Undergraduate students of the University in Vientiane also attended this workshop in addition to government officers and consultants related to transport and planning sectors who came from various parts of the country.

Chapter 4. Overview of Comparison of Attitudes toward Walking

4.1 Aim of analysis in the context of research framework

Now we refer back to the framework presented in Figure 2-1 and select one pairing to analyze. In this chapter, we discuss the confection referred regional environment labelled in that figure as (A) and Attitudes toward walking labelled as (ii). In this context, regional environment is quantified using characteristics such as population and special distribution and urbanization related to urban form. Information from other statistical data sources were helpful in this regard. Connection of such attributes to attitudes revealed from the field surveys are investigated in this chapter.

4.2 Opinion of respondents available from surveys

To determine the impression of walking in from the view point of respondents, following ten statements were posed in question 4 of the survey:

(a) I like walking.
(b) Walking is smart.
(c) I am willing to walk for a short distance every day.
(d) I like walking during my leisure times.
(e) I like to walk on roads that have pleasant scenery.
(f) I like to walk on roads through good neighborhoods even when the distance could be somewhat longer.
(g) I like to walk on streets where there are other people around even the distance could be somewhat longer.
(h) I prefer the shortest route when the neighborhood is not pleasant for walking.
(i) I think I walk faster than others.
(j) If there is no traffic, I often cross the road while the pedestrian signal is still red.

In this chapter we make use of responses to the first eight statements.

The first four statements, statements (a) through (d), indicate general attitude toward walking, while the next four statements, statements (e) through (h), indicate preferred routes for walking. Statements (i) and (j) relate to personal reflections of walking behavior which will be discussed in a later chapter.

The subjects were asked to rate the degree of agreement for statements using five levels (on a scale 0 to 4). Complete agreement with the statement was indicated by a value of 4, while strong disagreement with the statement was indicated by a value of 0. Statements that received a response greater than 2 were considered to be positive.

Overall results for the 10 Japanese cities surveyed in 2004 are presented in spider web form in Figure 4-1. Here, the statements (a) through (h) are taken into consideration. In general, citizens perceived 'walking' as a positive action, with a preference for routes with good scenery and surroundings.

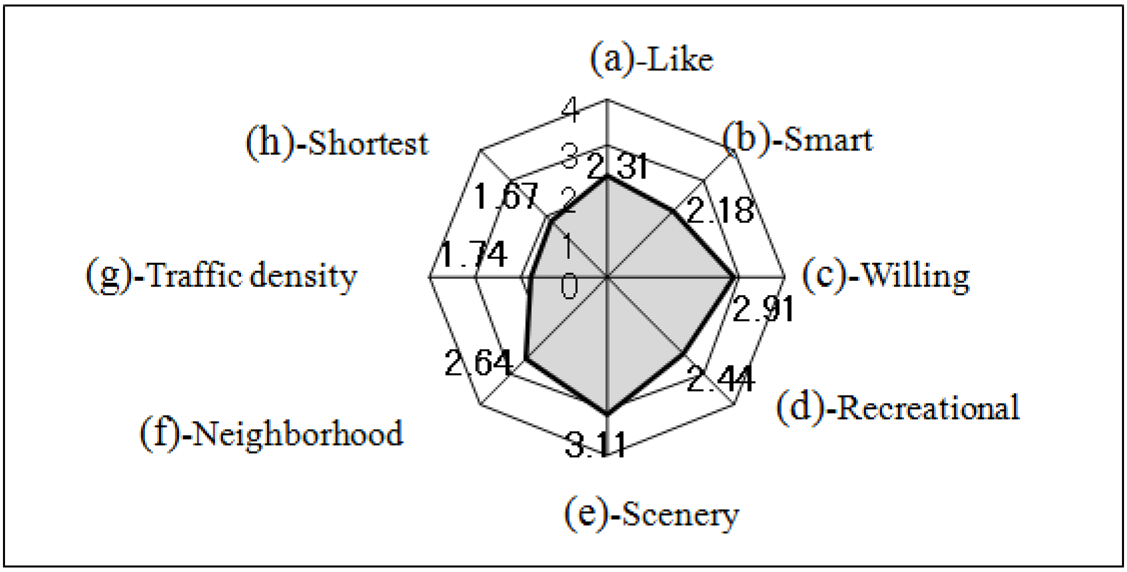


Figure 4-1 Average of scores about image of from respondents in ten cities in Japan

Figure 4.2 shows average scores at the level of each city. Comparison of results from the ten cities does not show a clear difference among the evaluations of walking as shown in Figure 4-2. All diagrams have a similar pattern with minor changes. Analysis of variance was performed to further investigate the results. Although the data obtained from questionnaires are rank order statistics, this study initially regarded their average as an ordinary continuous variable to be able to estimate the tendency. A detailed analysis required nonparametric statistics.

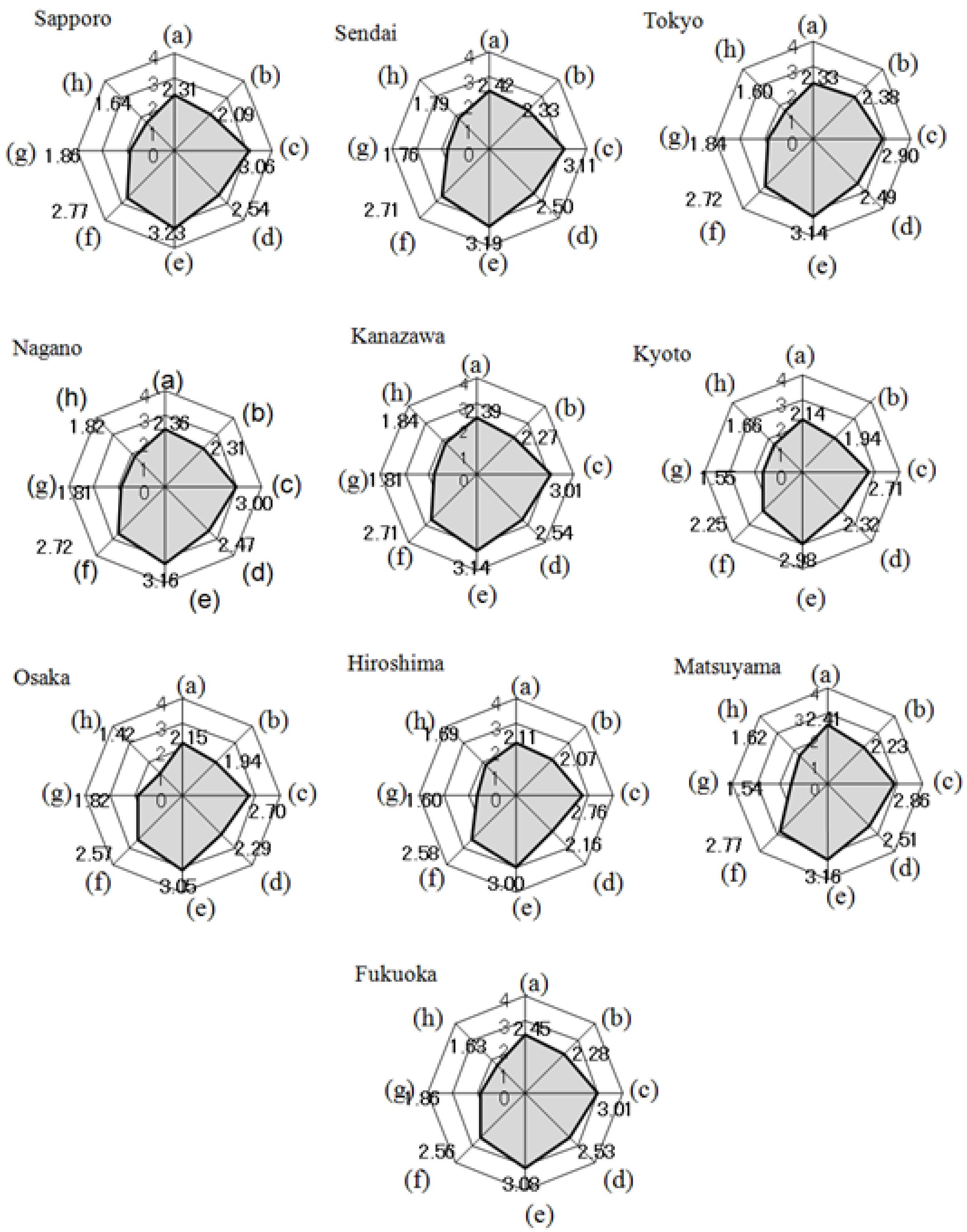


Figure 4-2 Average values of responses from the ten cities

The nonparametric variance analysis used here is the Kruskal-Wallis test and formulations explained in section 3.3.2. If equation (1) holds, a significant difference exists between the estimated average values. Results shown in Table 4-1 indicate that a regional difference exists in relation to five factors out of the eight considered.

Table 4-1 Results of Kruskal-Wallis test

Factors	$H(\chi^2)$	Degrees of freedom	$\chi^2_9(0.05)$	$\chi^2_9(0.01)$	Significance
b) Walking being smart	26.8	9	16.9	21.7	1%
e) Preference of a street with good scenery	17.5				5%
f) Preference for street with good surroundings	17.0				5%
g) Preference of a busy street	28.2				1%
h) Preference of the shortest route	20.8				5%

For the five factors that showed a significant difference among regions, the pairs of cities with significant differences were identified. Table 4-2 shows values resulting from using Bonferroni's method (mentioned earlier in section 3.3.2), and indicates that a significant difference of attitudes and perceptions about walking exists between respondents from number of cities. The > sign is introduced in the table to show what city scored the higher average value in the comparison. The comparisons indicated in the tabulation are significant at 1% level. For example, average score from respondents of Kyoto was higher (i.e. relatively more agreement to the statement) than from Osaka according to the statistical significance test.

Table 4-2 Significant difference between cities

Factor	City pairing where difference is significant
(a) Like walking	None
(b) Walking is smart	Tokyo > Matsuyama Tokyo > Sapporo Tokyo > Osaka
(c) Willing to walk a short distance daily	None
(d) Like a leisurely walk	None
(e) Prefer good scenery enroute	Osaka > Matsuyama
(f) Prefer good neighborhood enroute	Tokyo > Kyoto
(g) Prefer busy routes	Tokyo > Matsuyama Osaka > Matsuyama Fukuoka> Matsuyama
(h) Prefer shortest route	Kyoto > Osaka

As for the statements (a) through (d) which are related to general attitudes toward walking, there is no significant differences in scores for statements (a), (c) and (d) among cities. For the statement (b), the average score in Tokyo is larger than the other cities as indicated by the > sign. As for the statements (e) through (h) indicating the opinion about preferred routes for walking, there are significant differences among cities for all four statements.

4.3 Comparison between cities in Japan and Taiwan

The comparison between Japanese cities and other East Asian cities is an interesting extension to this research work. Sub-samples of respondents younger than 30 years are considered for this comparison as the age profiles of the survey samples from Japan and Taiwan were different as indicated in the previous chapter. The corresponding surveys were carried out in four cities (Tainan, Kaoshiung, Taichung and Chiayi in Taiwan as mentioned in the previous chapter.

The spider web patterns in Figure 4-3 show little difference between Japan and Taiwan samples for statements (a) through (d), which are related to general attitude toward walking. In contrast, there is a difference between the two counties for statements (e) through (h), which relate to preferred routes for walking. For example, the statement (f) 'I like to walk on roads through good neighborhoods even when the distance could be somewhat longer' and statement (g) 'I like to walk on streets where there are other people around even the distance could be somewhat longer' have received relatively higher scores in Taiwanese samples.

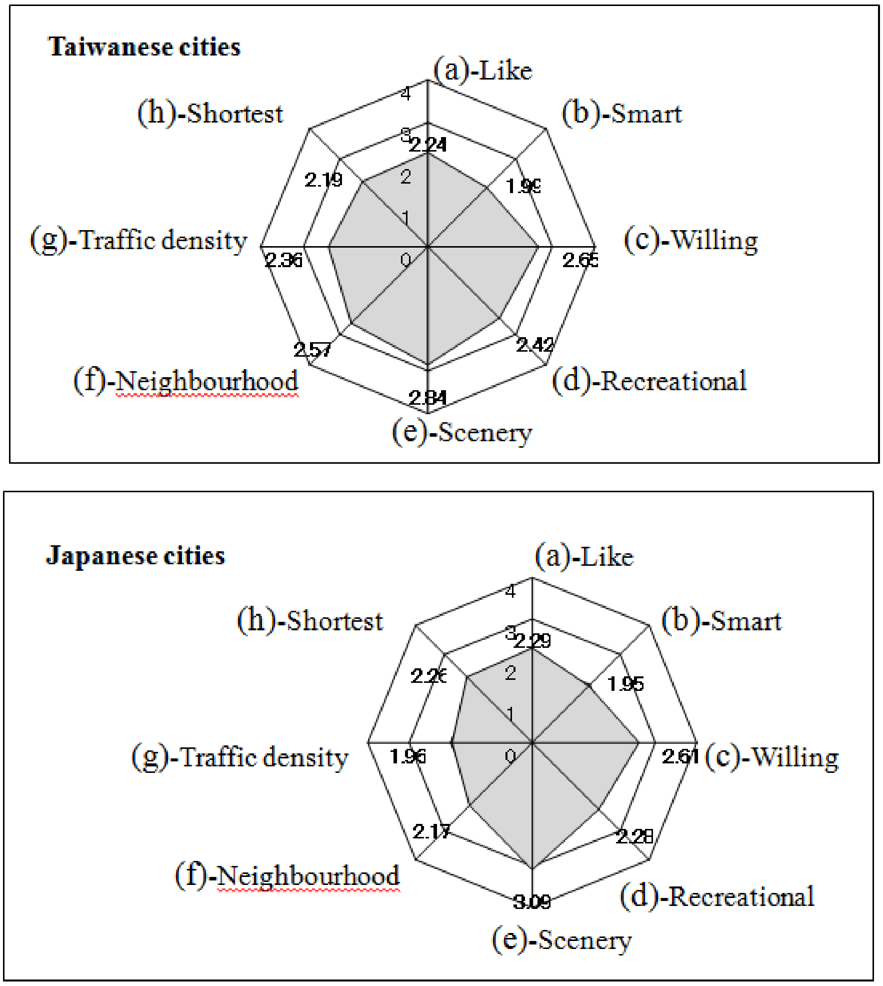


Figure 4-3 Comparison between cities in Japan and Taiwan about attitudes to walking of

respondents below 30 years of age.

4.4 Comparison among Japanese, Taiwanese and Korean cities and Sydney

Here, data obtained from two cities (Busan and Daegu) in South Korea and the Australian city (Sydney) are added to the investigation. These average values are presented in Figure 4-4, using all survey data obtained. At this step of comparison covering 4 countries, average values were computed from last two statements of the 10 statements as well. In other words, statements (i) and (j) covering personal reflections about walking habits were also added to the analysis.

Recall that general attitudes toward walking were included in statements (a) to (d). According to Figure 4.4, cities surveyed in Japan, Taiwan and Australia show an average value greater than 2.0 in the agreement scale. This shows positive attitudes toward walking in general in Japan, Taiwan and Australia. In comparison, Korean results show average values are below 2.0 for statements (a) to (d) indicating a somewhat negative attitude regarding walking.

Statements (e) to (h) related to preferred characteristics of pedestrian paths shown in Figure 4-4 indicate a much larger spread. The statements (e), "I prefer a street with pleasant scenery for walking", and (f) "I prefer a street with good surroundings (neighborhood), even when the distance could be longer" have similar level of high agreement from pedestrians in cities in Japan, Taiwan and Australia. Strangely, the average score obtained from Korean respondents were less than 2.0 and this means a disagreement with the need for a pleasant environment for walking. On the other hand, for the statements (g) "I prefer a street where there are people, even when the distance could be longer" and (j) "I often cross a road during a red signal if there is no traffic", Korean respondents have stated a relatively stronger agreement.

The spider-web representation adopted here has been able to display these observations in an effective manner. Figure 4-4 suggests that there is a difference among views from pedestrians of the four countries. However, difference between results from Japan, Taiwan, and Australia are relatively small in comparison to differences with South Korea. It is acknowledged that the of the survey sample selection method adopted in South Korean cities may explain portion of this difference.

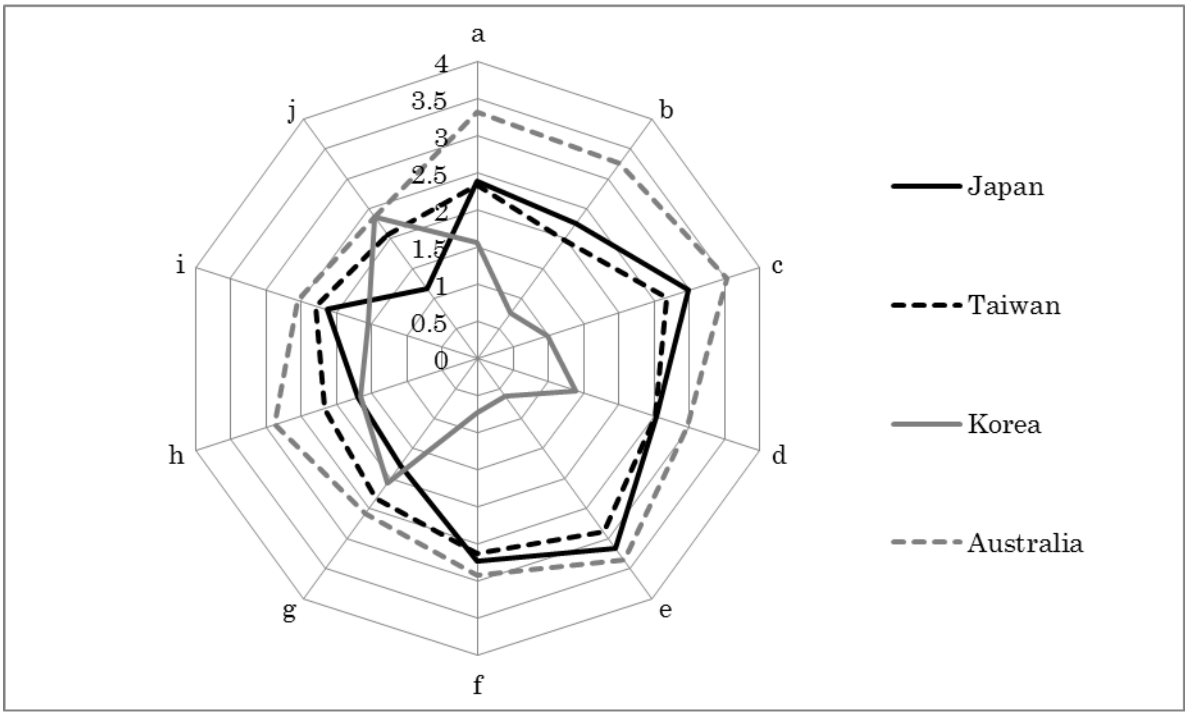


Figure 4-4 Comparison of attitudes toward walking among the four countries

Then, Table 4-3 has been prepared using non-parametric variance analysis. Average values of agreement scored have been ranked using the > sign according to the magnitude from the largest to the smallest. The differences are significant at 95% confidence interval. In all statements, Australian sample showed the highest average score among the four countries. For statements (a) (d), (e) and (f), the rank sequence is Australia, Japan, Taiwan and South Korea. As for statements (g) and (f), the order is Taiwan, South Korea, and Japan. In the case of statements (i) and (j), the sequence shows a different pattern to compared to previous statements.

Table 4-3 Ranking of scores of different attributes

	Significant deference among countries
(a) I like walking	Australia > Japan and Taiwan > South Korea
(b) Walking is smart	Australia > Japan > Taiwan > South Korea
(c) Willing to walk a short distance daily	Australia > Japan > Taiwan > South Korea
(d) I like walking for leisure	Australia > Japan and Taiwan > South Korea
(e) Prefer good scenery en-route	Australia > Japan > Taiwan > South Korea
(f) Prefer good neighborhood en-route	Australia > Japan > Taiwan > South Korea
(g) Prefer busy routes	Australia > Taiwan > South Korea > Japan
(h) Prefer shortest route	Australia > Taiwan > South Korea and Japan
(i) Fast walker	Australia > Taiwan > Japan > South Korea
(j) Regular signal violator	Australia and South Korea > Taiwan > Japan

Figure 4-5 shows an extension of this evaluation using the principle component analysis. Principle component analysis and applications will be explained later in Chapter. This technique reorients the database to visualize the average scores using the most significant axis system. The axis system shown does not have a specific physical meaning except that viewing from that orientation makes the most sense in a statistical analysis viewpoint.

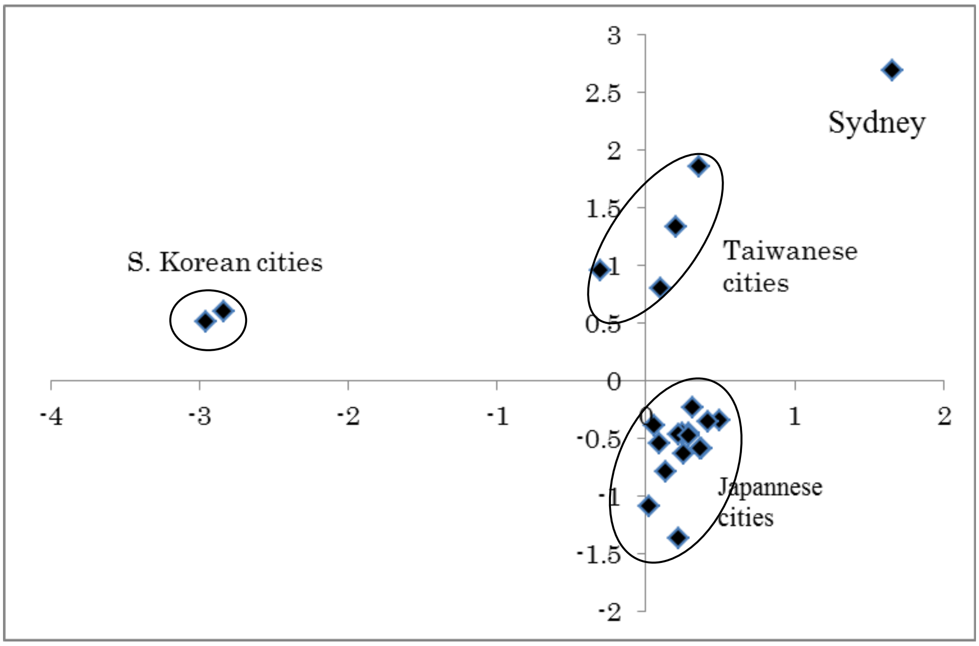


Figure 4-5 Grouping of cities based on similarity of responses to the 10 statements in survey.

There is a clear pattern of clustering possible when the principle component analysis technique is applied to response values for the 10 statements included in the survey. This indicates that there are distinct and substantial differences in data properties between countries compared to the noise or distribution measurable in scores for the statements in cities within one country.

4.5 Conclusions

This chapter discussed similarities and differences among pedestrians in four countries (Japan, Taiwan, South Korea, and Australia) analyzing results for level of agreement to statements in the questionnaire surveys. There are differences in pedestrian attitudes and behavior among the four countries. In Japan, Taiwan and Australia, the average score exceeded the midpoint 2.0 of the agreement scales indicating a generally positive attitude towards walking. On the other hand the average scores were low in South Korea. However, it is recognized that the survey sample selection bias have contributed this result. The questionnaire forms were distributed during classes for motor vehicle driving competency in surveys conducted in South Korea.

Differences of attributes among countries are larger than differences within each country, which suggests that characteristics peculiar to each country play an important role in formation of respondent attitudes related to pedestrian activities. It is noteworthy that, the spider-web representation indicates similar shapes for Japan and Taiwan. However, a statistical comparison using a non-parametric variance analysis has shown that there are multiple differences between pedestrian attributes of the two counties. The method has been also effective in identification of differences among 10 cities in Japan. In general, respondents in large cities expressed more positive opinion than those in small cities.

Chapter 5. Effect of Climate on Pedestrian Attitude towards Walking

5.1 Relevance of this chapter to the overall framework of pedestrian travel behavior

From point of view of the framework previously mentioned in Figure 2-1, this chapter considers the same pairing as selected in Chapter 4. The connection between regional environment depicted as (A) in Figure 2-1 and attitudes toward walking indicates as (ii) is the topic area of this chapter as well. However, particular attention paid here to issues related climate and topography aspects in consideration of the regional environment.

5.2 Classification of urban areas form a climate point of view

5.2.1 Köppen climate classification

Wladimir Peter Köppen in 1923 devised an arrangement now known as Köppen climate classification based on distribution of vegetation. This system classifies regions primarily based on temperature and rainfall, which is a convenient and effective structure to discuss climate and agriculture. It has been pointed out that this method is not necessarily suitable for analysis related to human settlements. This problem is acknowledged, but Köppen classification method is utilized here because of its widespread use in literature.

Köppen climate classification divides regions into five groups. They are groups A (tropical/megathermal climates), B (dry climates), C (mild temperature/mesothermal climates), D (continental/microthermal climates), and E (polar climates). Cities considered in this study belong to Groups A, C and D. Group A regions have a tropical humid climate. The average temperature of the coldest month is more than 18 °C. Group C regions have mild mid-latitude climate. The average temperature of the coldest month is between 3°C and 10 °C and the average temperature of the highest month is higher than 10 °C. Group D regions have a severe mid-latitude climate where average temperature of the lowest month could be less than - 3°C and the average temperature of the highest month is higher than 10 °C.

The classification system further subdivides these regions according to different rules. Group A is subdivided into Af (f: rain*f*orest), Am (m: monsoon), Aw (w: dry *w*inter), and As (s: dry *s*ummer) based on humidity. Group B is subdivided into Cw (dry *w*inter), Cs (dry *s*ummer), and Cf (no dry season) based on rainfall and temperature. Group D is also subdivided into Dw (dry *w*inter), Ds (dry *s*ummer), and Df (no dry season) based on temperature. Another level of sub-classification is also available for C and D regions based on average temperature of the significant season.

It has been observed that cities covered in this project falls into one of four sub-classifications of this classification system. They are:

Cfa : These regions have an average temperature of the coldest month greater than 22 °C. These areas have a humid subtropical climate with mild with no dry season and hot summer. Large part of Japan belongs to group C. Out of 15 cities surveyed during the project, 14 cities except for Sapporo are in category Cfa. Also Sydney is in such a climate zone.

Cwa : These regions have a humid subtropical climate. Three cities covered in Taiwan surveys are in such a climate. They are Tainan, Taichung, and Chiayi. Also Busan and Daegu, the two cities considered in South Korea are in such a climate.

Dfa: These regions have a humid continental climate with no dry season and hot summer. Sapporo belongs to this category.

Am: These regions have a tropical monsoonal climate with and heavy monsoon rains and a short dry season. Kaoshiung is classified under this category.

The assignment according to the climate classification system is displayed on country maps shown in Figure 5-1.

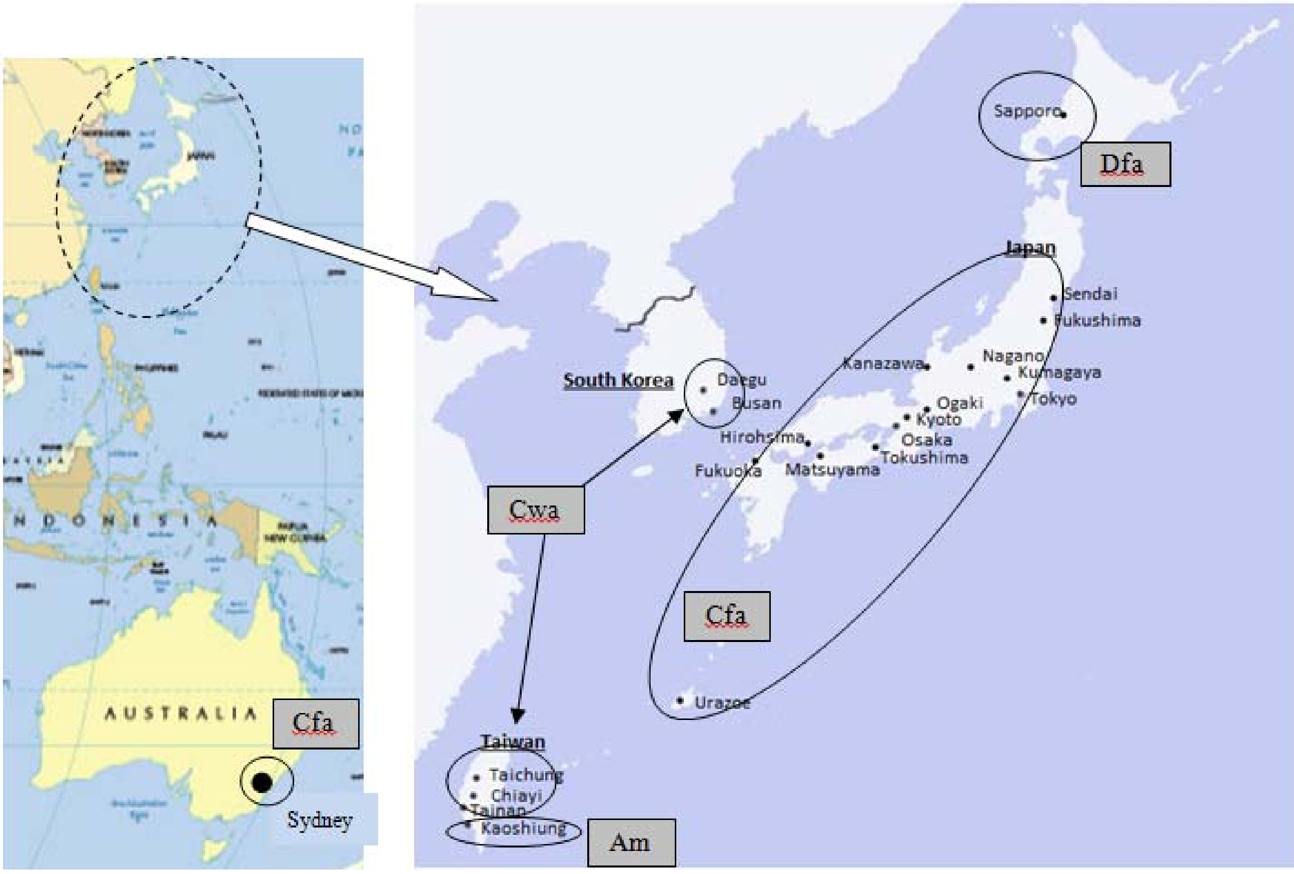


Figure 5-1 Assignment according to Köppen climate classification

5.2.2 Alternative classification according to climate

Whereas Köppen climate classification makes use of distribution of vegetation, it is possible to simplify the classification by only referring to the distribution of monthly average temperature. This method relies on two temperature indicators, (a) the yearly average temperature and (b) the range of monthly average temperature. In the cities surveyed in Japan, Taiwan, and South Korea, the highest temperature in summer is not much different, but in winter there are large differences of average temperature. The grouping created with the use of yearly average and range of monthly average for temperature measurements are shown in Figure 5-2. These groupings are shown on maps included in Figure 5-3. This shows a comparatively simple grouping pattern in line with a proximity to other cities.

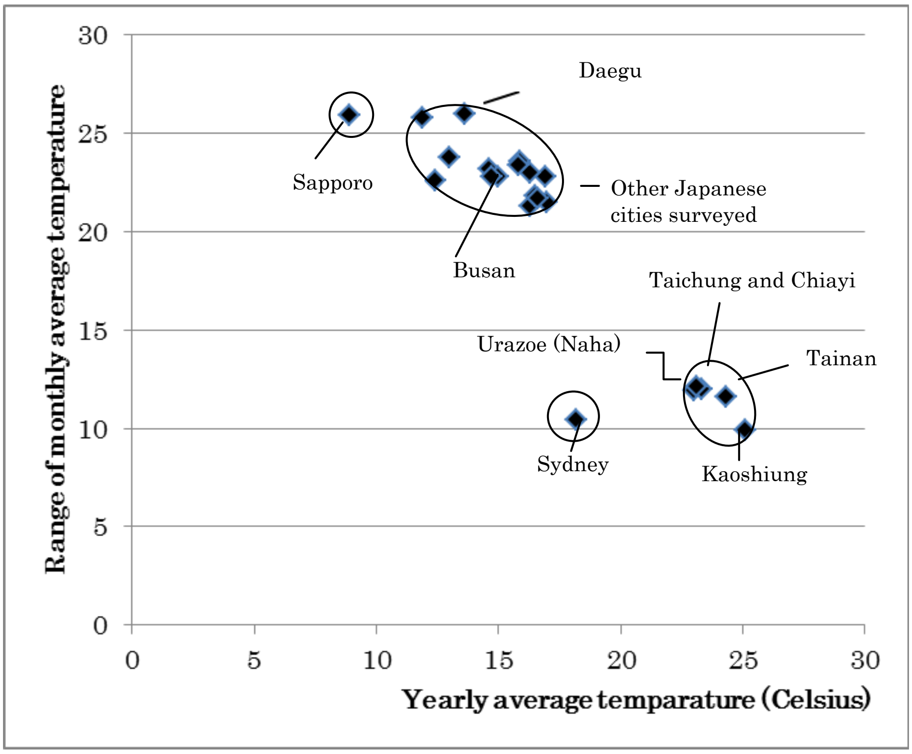


Figure 5-2 Grouping of cities based on temperature

As shown in Figure 5-3, four cities covered in Taiwan and Urazoe have similar climate according to the temperature classification. (Only a limited amount of temperature data was available from Urazoe. Therefore, data obtained from a nearby city Naha were used for this classification). This grouping is different to the grouping formed using Köppen method. Also, Japanese cities except for Urazoe and Sapporo, and the two cities considered from South Korea are located closely belongs to one group according to the classification based on temperature indicators. These cities were classified into different groups, i.e. Cfa and Cwa, according to Köppen method.

Differences in basic climatology classification systems as shown in maps presented in Figures 5-1 and 5-3 show a difficulty underlying attempts to explore the relevance of climate to formation of pedestrian attitudes.

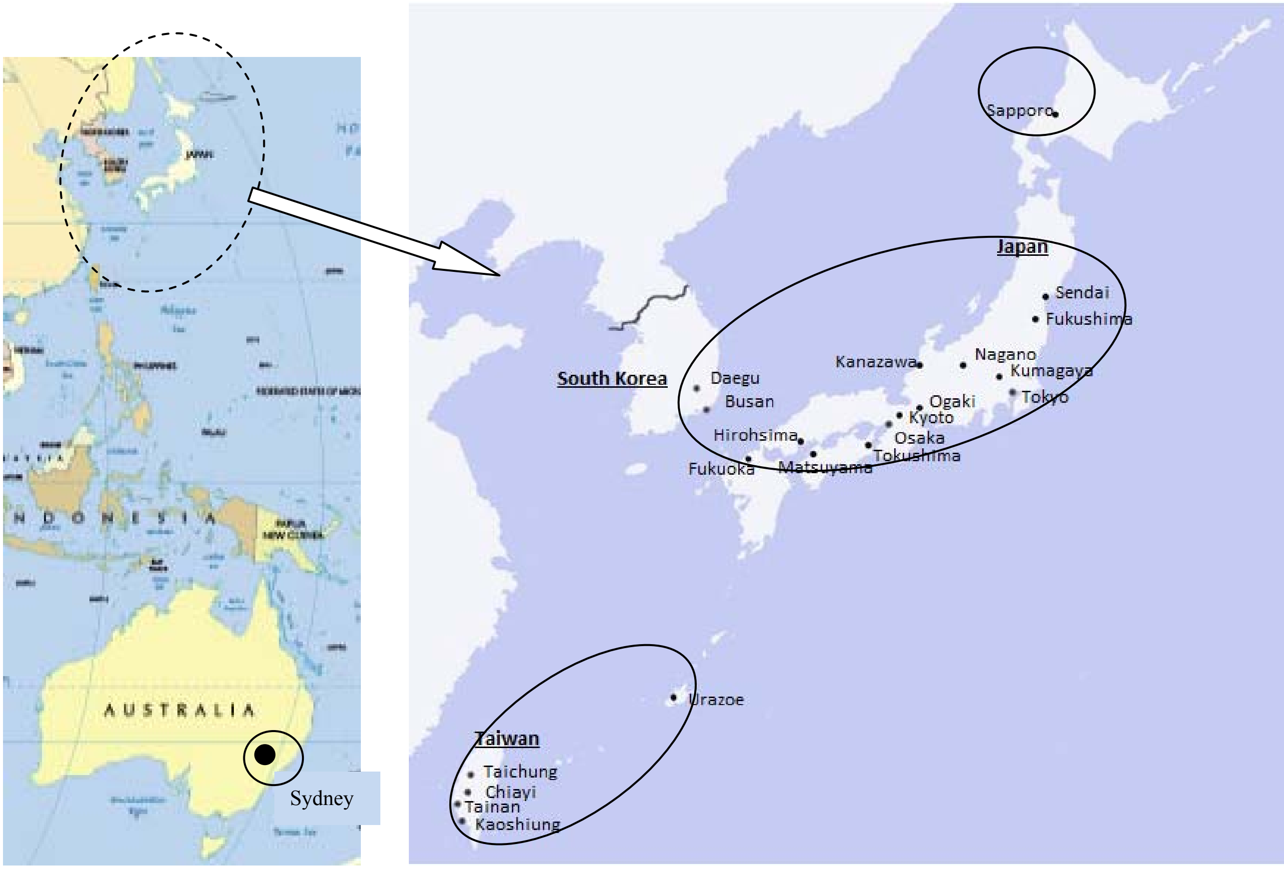


Figure 5-3 Classification of cities by the yearly average temperature and distribution of monthly average temperature

5.3 Effects of climate on pedestrian attitudes

For the purpose of comparison with the climate classifications it is helpful to revisit results from analysis presented in the previous chapter about attitudes of pedestrians. Therefore, clustering results shown in Figure 4-5 is now presented in the map form as shown in Figure 5-4. In a visual sense, the four cluster pattern shown in Figure 5-4 has similarities to Figure 5-3. Although the visual pattern observed in Figure 5-1 based on Köppen method is not as good a match with Figure 5-4, there is sufficient similarity to agree that there is a possible connection between climate and pedestrian attitudes irrespective of the climate classification methodology adopted. The comparison of these clusters of locations on maps has provided a visual indication that there is a relationship between regional climate and pedestrian attitudes.

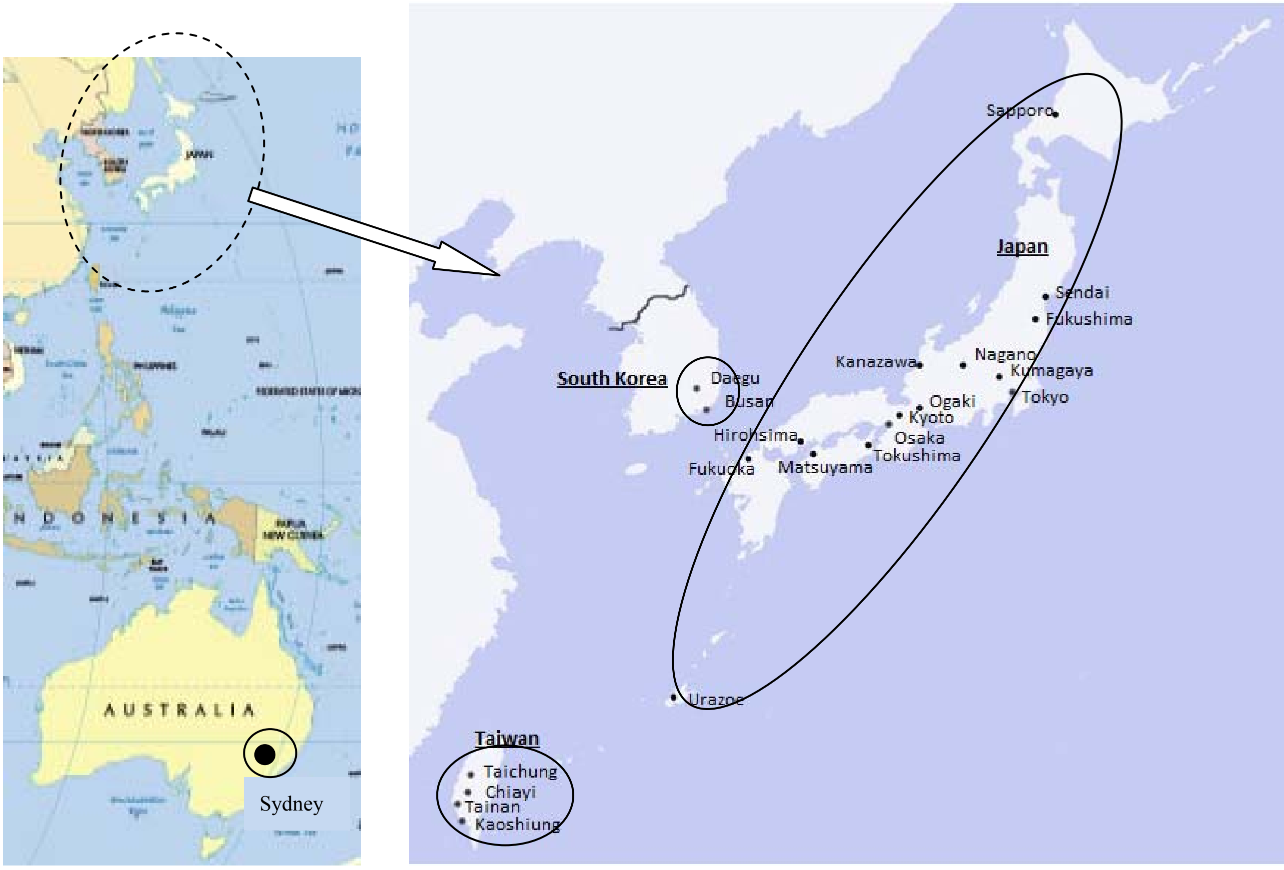


Figure 5-4 Clustering of surveyed cities according to overall attitudes scores

5.4 Conclusions

We have considered two different types of classification methods for geographic regions from a climate point of view. A widely used method is the 'Köppen climate classification'. 22 cities covered in field surveys were grouped into four climate zones according to this method and a simpler method only based on temperature indicators. Comparison of these groupings with grouping formed by cluster analysis of pedestrian attitudes has shown that there is a possible connection between climate and pedestrian attitudes.

It may be logical to expect regional climate to have an influence on many aspects of citizens including pedestrian attitudes. However, the strength of this relationship is not yet clear. The methodology followed here is also complicated by the presence of different schemes for classification of climate zones. Nevertheless there is sufficient evidence now to consider climate as one factor, although it may not be a dominant factor, that may be useful in prediction of pedestrian attitudes. However, it could be useful in identifying differences among different regions. For example, climate differences may reasonably explain some differences of attitudes toward walking in Japan and Taiwan.

Chapter 6. Effect of Stage of Life on Pedestrian Attitudes

6.1 Study framework of pedestrian travel behavior in this chapter

In this chapter, we discuss the relationship between *Sociological properties* and attitudes toward walking mentioned earlier using the study framework depicted in Figure 2-1. In this chapter, the specific *Sociological property* considered relates to *stage of life*.

This chapter consists of two parts. The first part describes the relationship between 'stage of life' and 'attitudes toward walking' using age as a proxy indicator of stage of life. Data collected during the first two stages of surveys have been utilized in this part of the chpater. The database used here included responses from fifteen cities of Japan, four cities of Taiwan, and two cities of South Korea.

Stage of life can be also explained in different ways as age may not be in perfect coincidence with different stages of life. Another way to categorize different stages of life could be based on marital status. Family type could be another method to classify individuals to different groups. The second part of the chapter adopts these alternative indicators to define stage of life. Analysis in the second part of chapter is based on a modified version of the questionnaire. The modified questionnaire and relevant details will be presented in a later section.

6.2 Analysis of impact of stage of life on pedestrian attitudes using age as a proxy variable

6.2.1 Classification of age for analysis

In a simplified sense, age could be a proxy variable for stage of life. This section looks at the current topic from this simple and convenient viewpoint. Stage of life implies a combination of attributes such as marital status, number and age of children and employment status which were not covered in the original surveys performed. Therefore, age is selected as the descriptive variable for the initial analysis assuming that stage of life has a co-relationship with the biological age. However, it is acknowledged that age may represent stage of life only to a limited extent.

In our survey, age was recorded at intervals of 20 years, in other words, respondents were grouped into four age groups designated as 'below 20 years', '20 – 40 years', '40 – 60 years' and 'above 60 years'. Section 3.2 has already presented the sample distributions according to gender and age.

6.2.2 Analysis for responses from cities in Japan

Table 6.1 shows relevance of gender and age on scores assigned by respondents to attitude statements. Here, statistical analysis was performed using the methodology described in Chapter 3. As done in earlier chapters and tabulations, the > sign indicates which group provided the larger average score. From the first row of the table, it can be seen that there is no impact from gender on the four attitude statements, i.e. male and female sample-subsets have not shown a significant difference for those statements. Comparison with age groups, as shown in the next row of the table shows statistically significant differences between certain age groups for three of the four attitude statements. In general, older age groups have more positive attitudes toward walking according this comparison.

Table 6-1 Comparison of attitude statements based on gender and age groups

Variable	(a) Like walking	(b) Walking is smart	(c) Willing to walk a short distance daily	(d) I like a leisurely walk
Gender	None	None	None	None
Age group	None	20~40 > below 20 40~60 > below 20 Above 60 > below 20*	40~60 > below 20 Above 60 > below 20 Above 60 > 20~40	Above 60 > 20~40*

Note * = difference significant at 5%. All others at 1% significance level.

Also, age group has an impact on responses to certain statements related to route choice considered in this survey as shown in Table 6-2. For example, older age groups have a stronger preference for streets with good surroundings, even when that route is not the shortest. The statement concerning the route distance shows younger groups have a stronger preference for the shortest route than other age groups. In some sense this finding is not intuitive when one considers younger age groups are physically strong in general and able to better cope with distance than older groups. However, the potential flexibility with the time budgets available to older groups may explain these preferences.

Table 6-2 Comparison based on gender and age groups for route preference statements

Variable	(e) Prefer pleasant scenery	(f) Prefer good neighborhood	(g) Prefer busy route	(h) Prefer shortest route
Gender	None	Female>male	Female>male	Male>female
Age group	None	Above 60 > below 20 Above 60 > 20-40 Above 60 > 40-60 40~60 > 20-40 40~60 > below 20*	None	Below 20 > above 60 20-40 > above 60 Below 20 > 40~60 20-40 > 40-60 Below 20 > 20~40*

Note * = difference significant at 5%. All others at 1% significance level.

Further analysis of statements on personal behavior of walking speed and signal violation habits displayed in the next table shows that there is a significant difference of the two behavior elements with differences in gender and age groups. Males have assessed them as faster walkers more often than females. Similarly, young age groups have assessed them as faster walkers than older persons. Also there are differences in signal violation habits corresponding with differences in gender and age groups.

Table 6-3 Comparison based on gender and age groups statements on personal reflections

Variable	(i) Fast walker	(j) Regular signal violator
Gender	Male > female	Male > female
Age group	20-40 > above 60 40~60 > above 60	20~40 > below 20 40~60 > below 20 Above 60 > below 20*

Note * = difference significant at 5%. All others at 1% significance.

Above analysis was performed using all data from all cities surveyed collectively to obtain a preliminary view of the comparison. Next section can now present the comparison from the point of view of each country considered here.

6.2.3 Analysis in the three countries

Table 6-4 summarizes the patterns of attitudes toward walking with respect to the age groups in the three countries. Here, age is adopted as the proxy variable for the stage of life as mentioned earlier. Again, the statistical method used here is the non-parametric variance analysis mentioned in a previous section. When there is a difference, we indicate the age group that provided the more positive score using the mathematical symbol for larger than sign. For example, 'Below 20 > 20-40' means that the age group less than 20 years old provided a higher score than group 20-40 years old. When the difference of the average scores between the age groups were not statistically significant, the tabulation has a blank cell denoted by the - symbol.

When there is a statistical difference between scores where a younger group score is lower than that of an elder group, bold letters are used in the tabulation in addition to the use of the appropriate mathematical symbol. This type font selection is done to assist the visual inspection of the tabulation. On the other hand, when there is a statistical difference between scores where the score of a younger group is higher than that of an older group, regular fonts are used.

Results presented in Table 6-4 indicate that the age group of respondents makes a difference in the level of attitudes toward walking as well as preferences and awareness. As for the statements (a) through (d) that indicate general attitudes toward walking, the younger generations scored lower than the older generations in Japan and Taiwan. This means younger groups are less positive in attitudes toward walking than the older population in these countries. Results for South Korea show the opposite trend. There, general attitudes toward walking appear to deteriorate as one advances through different stages of life. This indicates that a different family of policies related to pedestrian infrastructure planning for elderly may be warranted in South Korea compared to the other two countries.

Statements (e) through (j) represent characteristics of preferred routes for walking and personal reflections of walking behavior. Table 6-4 shows that the stage of life as indicated by age of respondents, makes a difference in the three countries to preferences and the stated behavior of respondents, according to majority of statements put forward to them. However, the distribution pattern of results for individual statements is different among the three countries. For example, in relation to the statement (f), score of younger groups is lower than that of relatively older groups in Japan; it is the opposite in South Korea, in other words, score younger groups higher than that of older groups there; and a mixed pattern is observed in Taiwan. Anyhow, an interesting pattern has emerged in Table 6-4 when we ignore the magnitudes and focus on the direction of the comparison signs (also highlighted by the use of bold and regular fonts). Recall that the lower age group is always stated first in the comparison. In majority of situation in the tabulation, the comparisons move in one direction according to the chronological age. For example, in the row for statement (a), for Taiwan results, the response scores become more positive as respondents grow older. In contrast, in row (d), for results from South Korea, the scores become less positive as respondents grow older and move through different stages of life. Although there are some exceptions, the response scores generally display a unidirectional movement with age for a given variable in a selected country.

We agree that further research is required to find specific reasons for the movement of attitudes in different directions in different countries at different stages of life. However, differences observed in Table 6-4 have provided statistical evidence for the context of the influence of regional characteristics on pedestrian behavior.

Table 6-4 General attitudes toward walking by age group

	Japan	Taiwan	South Korea
(a) I like walking	-	Below 20 < 20~40 Below 20 < 40~60 Below 20 < above 60 20~40 < 40~60 20~40 < above 60	-
(b) Walking is smart	Below 20 < 20~40 Below 20 < 40~60 Below 20 < above 60*	Below 20 < 20~40 Below 20 < 40~60 Below 20 < above 60 20~40 < 40~60 20~40 < above 60	20~40 > 40~60
(c) Willing to walk a short distance daily	Below 20 < 40~60 Below 20 < above 60 20~40 < above 60	Below 20 < 20~40 Below 20 < above 60	-
(d) I like a leisurely walk	20~40 < above 60*	-	Below 20 > above 60* 20~40 > above 60*
(e) Prefer good scenery en-route	-	Below 20 < 20~40 20~40 > above 60	-
(f) Prefer good neighborhood en-route	Below 20 < above 60 20~40 < above 60 40~60 < above 60 20~40 < 40~60 Below 20 < 40~60*	Below 20 < 20~40 Below 20 < 40~60 20~40 < 40~60 40~60 > above 60*	-
(g)Prefer busy routes	-	-	Below 20 < 40-60 Below 20 < above 60 20~40 < 40~60* 20~40 < above 60*
(h) Prefer shortest route	Below 20 > above 60 20-40 > above 60 Below 20 > 40~60 20-40 > 40-60 Below 20 > 20~40*	Below 20 < 20~40*	20~40 < 40~60
(i) Fast walker	20-40 > above 60 40~60 > above 60	Below 20 < 40~60 20~40 < 40~60 40~60 > above 60	-
(j) Regular signal violator	Below 20 < 20~40 Below 20 < 40~60 Below 20 < above 60*	Below 20 > 20~40 Below 20 > 40~60	Below 20 < 40~60 Below 20 < above 60 20~40 < 40~60 20~40 < above 60 40~60 < above 60*

Note - indicates failed to show a statistically significant difference. * indicates difference is significant at 5%. All others have a difference significant at 1%.

6.3 Analysis of impact of stage of life on pedestrian attitudes using other variables

6.3.1 Other variable considered

As shown in the previous section, to a certain extent, issues of stage related to life can be investigated using age of respondents as a proxy variable. However, age is only one indicator and not the complete explanation of stage of life. In this section, the stage of life is brought into the discussion through the use of variables such as marital status and household size. Riley (2006) has studied the influence of stage of life on non-motorized transport use and has shown that families with children are relatively more car dependent and therefore less likely to be engaged in walking and cycling except as a leisure activity. Richardson (2006) has discussed the household structure as a stage of life indicator for transport modeling work. He showed that the average age of family members was a useful indicator for the purpose of transport modeling work particularly in relation to trip generation models. The importance of stage of life from the pedestrian safety perspective has been presented in analysis performed by number of data management authorities including National Centre for Statistics and Analysis (2012). As expected, such analysis shows vulnerability of the elderly and young children in pedestrian accidents. Regrettably, age groups representing elderly and children are over-represented according to pedestrian accident data.

The stages of life have been defined in many ways to suit different cultures and religions. Most recognize the human life cycle as having several distinct stages followed by all living creatures, for example, birth, infancy, childhood, adulthood and elderly. Such classifications rely on progressing along with the age of the individual concerned. Additional sub-classifications such as adolescence, teenager and young adult are adopted in some work. For example, Armstrong (2007) has identified a twelve stage life cycle, namely; pre-birth, birth, infancy, early childhood, middle childhood, late childhood, adolescence, early adulthood, midlife, mature adulthood, late adulthood, and passing away. A similar classification is often applied in medical research to associate susceptibility to different ailments at various stages of life. In applications that relate to demand modeling work it may be suitable to adopt classifications borrowed from the field of marketing research where there is an additional emphasis on spending capacity and the range of activities carried out by individuals (Moschis, 1996).

In the previous section, an age based classification has been adopted assuming age as the sole indicator of stage of life. As mentioned earlier, this classification uses a numerical scale of age to broadly classify individuals to (a) children and youth, less than 20 years old (b) young, 20-40 years old (c) mature, 40-60 years old and (d) elderly, above 60 years of age. Another potential descriptive variable that could be adopted here is the marital status. This variable brings in additional characteristics to reflect the activity level and productivity of the individual to the society. To reduce the complexity of the survey in this project, marital status has been divided to only two categories as (a) single and (b) not single. It is acknowledged that 'single' could mean sub-categories such as never married, divorced, separated, and widowed. Therefore this variable as selected here may be infective in its ability to correspond to the stage of age.

A third variable available in the survey is type of family. This selection is based on the argument that position of the family structure can reflect the stage of life. Seven categories have been adopted in the surveys performed. Researchers may use terms such as; nuclear family, single parent family, and extended family. However, it has been decided to provide a rather descriptive wording to respondents of the survey. Thus the categories were labeled as; (1) live alone, (2) couple, no children yet, (3) family group containing parents and child(ren) and youth, (4) couple, children already left home, (5) three generations from grand-parents to children and youth, (6) in shared accommodation or hostel.

Another potential indicator of stage of life considered is how long the person has lived in the present city. It may be speculated that the individual is in a more advanced level in terms of stage of life if the person had been a resident in the present urban area for a comparatively long time.

It was only after the second stage of surveys was completed that the study team decided to modify the original questionnaire to allow for these variables in a meaningful manner to account for different stages of life. The modified survey was used in the subsequent surveys, earlier referred to as stage 3 surveys. Five cities in Japan, and Sydney in Australia were surveyed using this questionnaire in 2011. Surveys in Sydney were delayed till the latter part of the year as it involved translating the questionnaire to English and obtaining further approval of university ethics committees.

Recall that the original questionnaire applied in stage 1 and stage 2 surveys was shown earlier in Chapter 3. The modifications made to the original questionnaire for stage 3 surveys are summarized in Figure 6-1. The modified questionnaire consists of four parts. Parts 1 and 2 replaced the first page of the original questionnaire that contained three lengthy questions. Part 3 is essentially the same question as the question 4 in the original questionnaire survey, covering statements (a) to (j) about respondent attitudes. Part 4 covered original questions 5 to 11 with minor modifications as shown in Figure 6-1.

Part 1. **About Modes of Transport used**	
Q1 Approximately, how many times do you use public transport in a month?	…………….. times
Q2 What was the main trip purpose for using public transport?	□ Commuting (work/school) □ Shopping □ Leisure □ Other
Q3 Approximately, how many times do you travel by cars as driver or passenger in a month?	…………….. times
Q4 What was the main trip purpose for using cars?	□ Commuting (work/school) □ Shopping □ Leisure □ Other
Q5 Approximately, how many times do you use a bicycle in a month?	…………….. times
Q6 What was the main trip purpose for using a bicycle?	□ Commuting (work/school) □ Shopping □ Leisure □ Other

Part 2. **About Lifestyle Concerns**	
Q7 Do you want to develop environmentally friendly habits?	□ Yes □ No
Q8 Do you prefer to live near or within city center?	□ Yes □ No
Q9 Although the living environment may be worse, do you want to live in a more convenient location than now?	□ Yes □ No
Q10 Are you involved in any volunteer activities, this period?	□ Yes □ No
Q11 Do you think yourself as an out-door or in-door person?	□ In-door □ Out-door □ Not sure
Q12 Do you think you get enough physical activity to maintain good health?	□ Yes □ No

Part 3. **About agreement with attitude statements**
This part is same as Question 4 of the original questionnaire shown in Figure 3.2 that mentioned attitude statements a to j.

Part 4. **About Yourself**	
This part is similar to Questions 5 to 11 of the original questionnaire. Questions 8, 10 and 11 about car ownership, city where spent most of lifetime and accident involvement were removed. Instead following two questions were added:	
• Marital status	□ Yes □ No
• Family type	□ Live alone □ Husband and wife □ Family group containing parents and child(ren) □ Child(ren) independent and already left home □ With grandparents, parents and child(ren) □ In shared-Accommodation/ hostel

Figure 6-1 Structure of the modified questionnaire applied for stage 3 surveys

6.3.2 Attributes of respondents

Figure 6-2 shows the gender distribution of samples for the cities surveyed. In all cities, the count of males is larger than the count of females. This is different from the expected property of general population where there are more females than males. Anyhow, this discrepancy maybe considered within acceptable bounds. In mail back surveys performed in Japan there may have been some tendency for male head of household to be the stated respondent although a female member may have completed the survey on his behalf. Nevertheless, even in the Sydney survey where the interviewer can physically see the respondent, the gender breakdown has followed the same pattern as in Japan surveys.

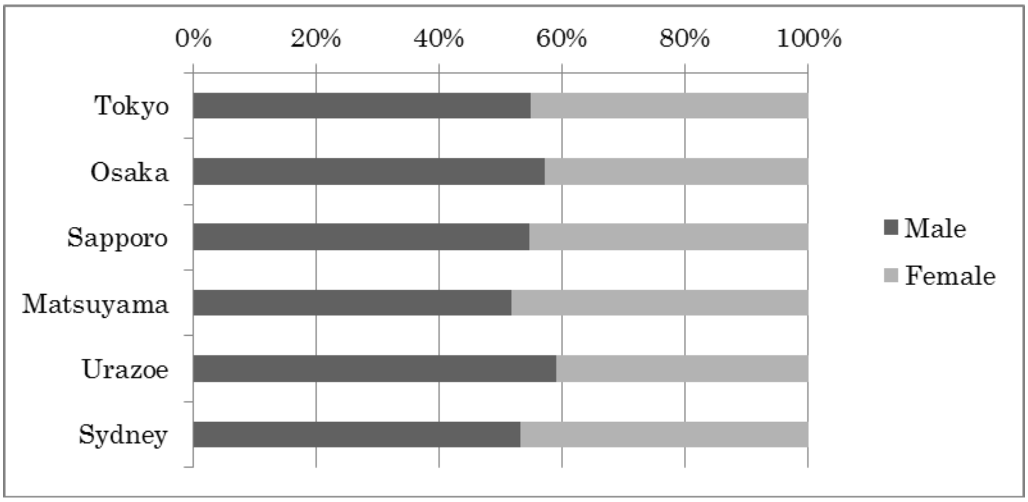


Figure 6-2 Gender distribution of respondents

The age distribution of respondents shown in Figure 6-3 is much different from that of the general population. Japan surveys conducted using mail back surveys have a large over-representation of the above 60 age group. This is mainly due to landline telephone ownership being biased towards that age group. The respondents were randomly selected from the city telephone directory and the observed age distribution is understandable. It is also possible that members of that age group were more willing to spend the time for questionnaire surveys. On the other hand, Sydney survey had almost 70% in the 20-40 age group. Selection of some survey sites near universities may have contributed this sample bias.

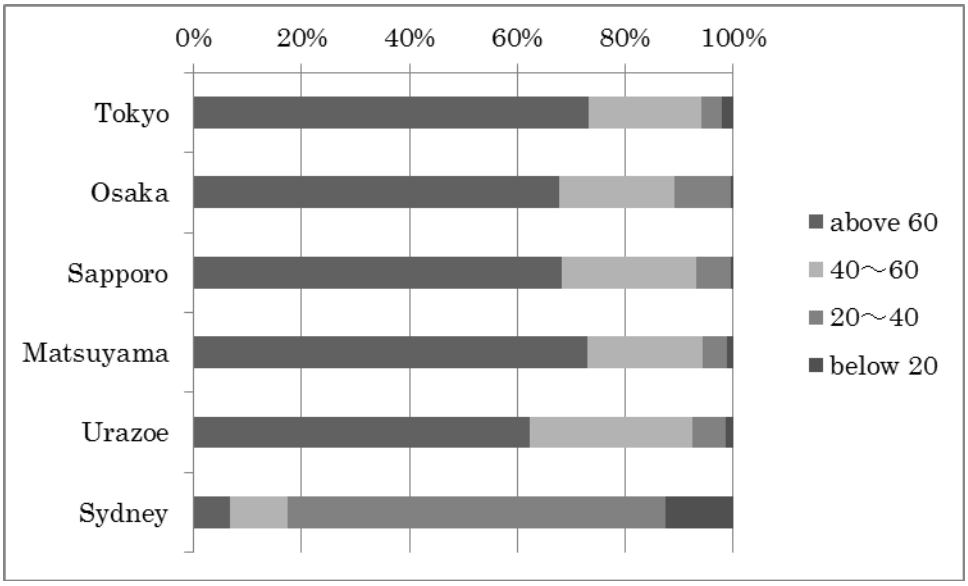


Figure 6-3 Distribution of age group of respondents

The distribution of marital status also indicates the influence of differences in data collection methods applied. Figure 6-4 shows that a large proportion of respondents in Japan is 'not single' which is consistent with the large proportion of elderly in those samples as shown earlier with Figure 6-3. On the other hand, Sydney sample consists of a large number of singles. This is consistent with the speculation stated earlier that this survey may be over-represented by university students.

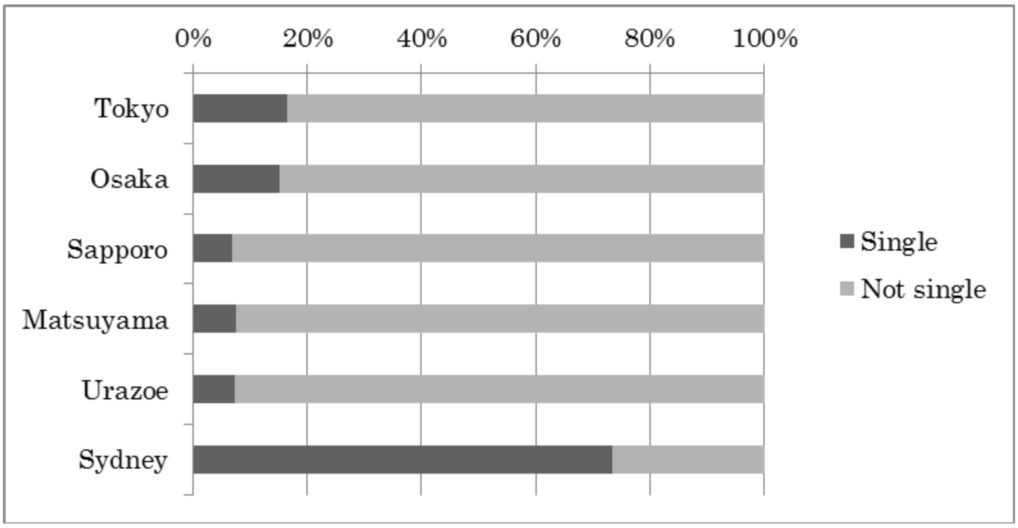


Figure 6-4 Distribution of marital status

Figure 6-5 shows the duration individuals claim to have lived in the current city. In the five cities in Japan the group that has lived more than 20 years in the present city is almost 80%. In contrast, there is distinctly different, even spread of residency period reported in the Sydney survey. This is also consistent with the disparity of the age distributions observed earlier.

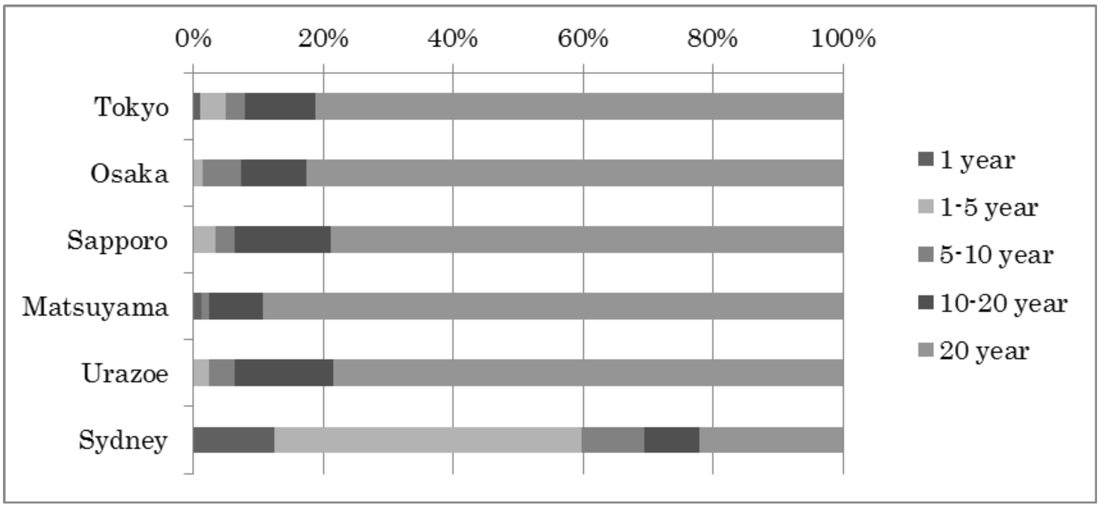


Figure 6-5 Distribution of time duration respondents lived in the city

It is evident that differences in survey administration methods have contributed to respondent demographics in the available samples. Surveys conducted in Japan has an unusually high number of respondents aged more than 60 years, who are married and have lived a long time in the current city. Sydney survey has a high number of young adults, not yet married and a somewhat even distribution of time they have spent in the current city. It is important to note that these biases are not a particular problem for the next sections of analysis continue to investigate the relationships among different demographic categories and focus on perceptions from the point of view of each subcategories. A mathematical method is later introduced to address this issue in a statistically valid manner.

6.3.3 Relationships among Stage of Life Variables

Relationships among different demographic attributes are investigated in this section. To simplify the process, age group is selected as the base variable and the other variables mentioned in the previous section are then considered to prepare cross tabulations for the purpose of this analysis. Figure 6-6 shows the relationship between marital status and age group using aggregate of all data for Japan and Sydney. As expected, the bar chart shows that 'not single' proportion increases as individuals proceed through stages of life from a zero percent married at childhood stage to more than 95% of respondents in the age group above 60 years.

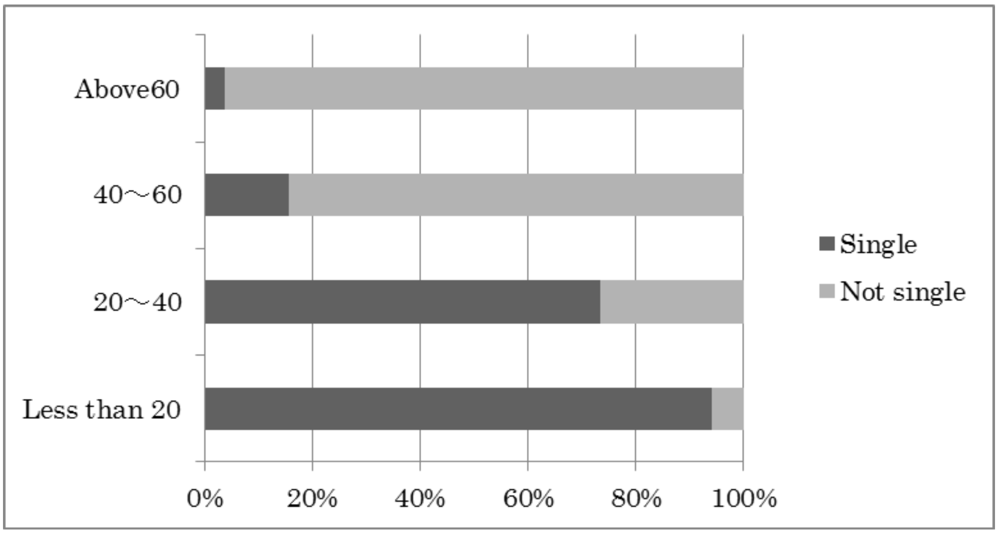


Figure 6-6 Proportion of married in the sample increases with age

The relationship between the family type and age also shows a discernible pattern. The proportion living with parents is understandably high for the lowest age group, and that proportion steadily decreases at subsequent age groups (Figure 6-7). On the other hand, husband and wife family type first emerges with the age group 20-40 and increases with following age groups until it attains the highest proportion at the most senior age group considered.

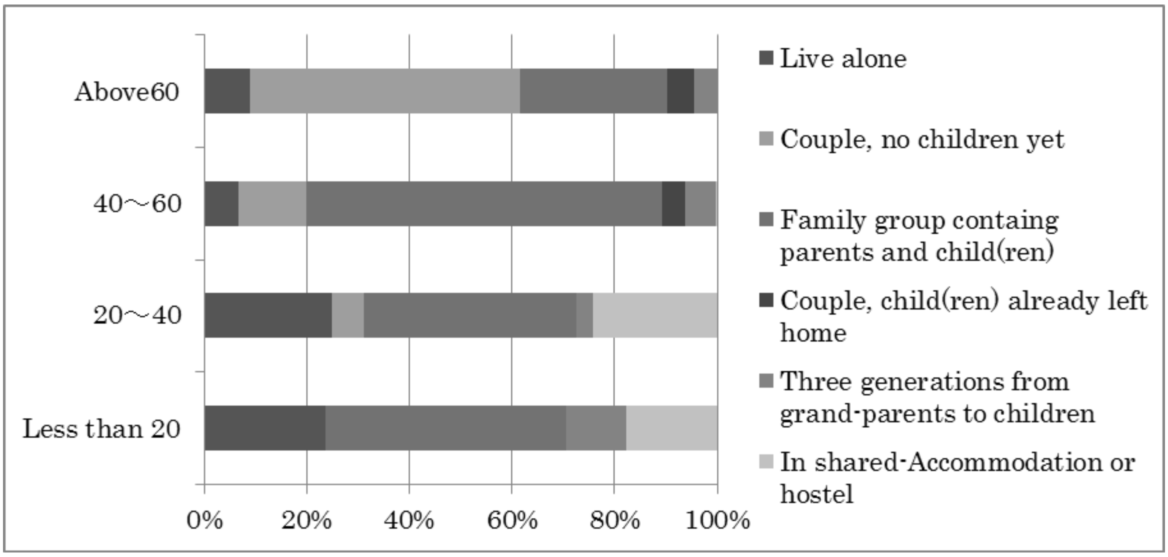


Figure 6-7 Bar chart of the relationship between family types and age groups

The time duration respondents have spent in the city also shows an identifiable pattern when compared with the age group as shown in Figure 6-8. Short periods of residency in the current city are more evident with low age groups. Percentage with a residency period of 20 years or more is steadily growing from low age groups until it reaches about 90% for the age group 60 years and above.

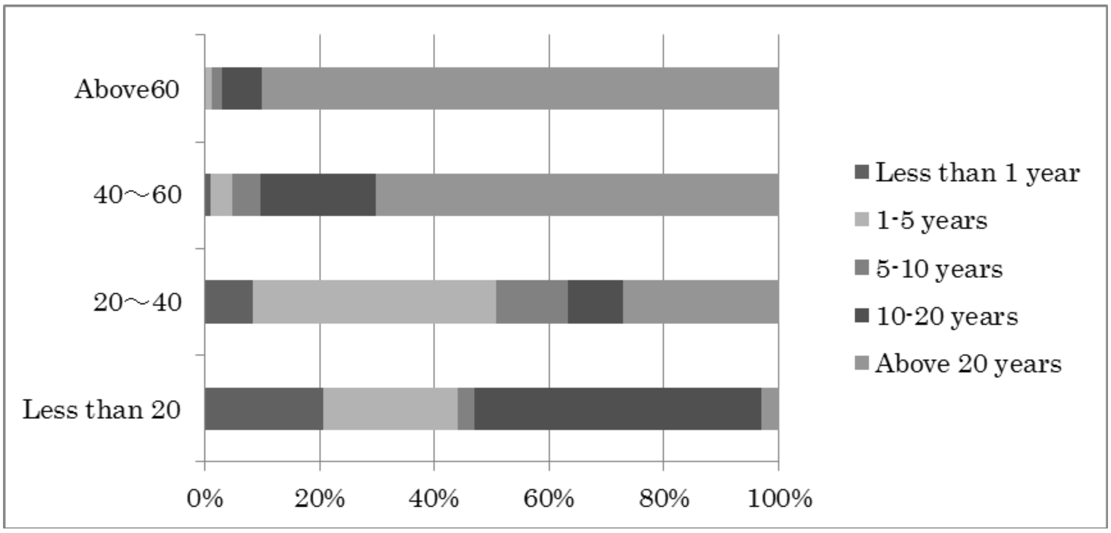


Figure 6-8 Cross classification pattern between age and residency period

Figures 6-6 to 6-8 have shown that there are interrelationships among variables considered here for stage of life. Encouragingly, variables considered have visible relationships with age group, which is a relatively easy variable to manage in data collection. Therefore, using age group as a proxy variable (as done earlier in section 6.2) for stage of life can be considered justifiable. Nevertheless, work presented in the next section takes into account all variables mentioned above to investigate the impact of stage of life on attitudes toward walking. The objective from the point of view of urban planning is to understand the importance of these attributes to identify needs of pedestrians in different stages of life.

6.4. Differences of pedestrian opinion according to stage of life

6.4.1 Patterns Related to Change of Pedestrian Opinions with Stage of Life

Results from application of Kruskal-Wallis test along with Bonferroni method are shown in Table 6-5. The tabulation shows the 10 opinion statements in rows and comparison tests according to different indicators for stage of life in columns. Empty cells indicate situations where the difference is not statistically significant although there may be a numerical difference between average scores calculated for opinion statements according to different stages of life. A notation such as A4 > A1 shown in the row for opinion 'f' for column 'Age-Japan' means that there is a significant difference between 'Age more than 60 years' (sample A4) and 'Age less than 20' (sample A1) scores for that particular opinion statement (i.e. preference for pedestrian paths through good neighborhoods). The sign ">" indicates that the average score of sample A4 is larger (i.e. more positive) than that of sample A1.

Table 6-5 Statistical analysis according to stage of life indicators; age, marital status and type of family structure

	Age		Marital status		Family type	
Statement	Japan	Sydney	Japan	Sydney	Japan	Sydney
(a) I like walking	–	**A3>A1***	–	–	–	–
(b) Walking is smart	–	–	–	–	–	–
(c) Willing to walk a short distance daily	–	–	–	–	–	–
(d) I like a leisurely walk	–	**A3>A1***	–	**M2>M1***	–	–
(e) Prefer good scenery en-route	–	**A3>A2***	–	–	–	–
(f) Prefer good neighborhood en-route	**A4>A1**	**A3>A1**	**M2>M1**	–	F2>F3	–
	A4>A2	**A3>A2***	–	–	F2>F5	–
	A4>A3*	–	–	–	–	–
(g) Prefer busy route	A3>A4*	–	M1>M2	–	–	–
(h) Prefer the shortest route	A1>A4*	–	M1>M2	–	–	–
	A2>A4	–	–	–	–	–
	A3>A4*	–	–	–	–	–
(i) Fast walker	A3>A4	–	–	–	–	–
(j) Regular signal violator	A1>A4	A1>A4*	M1>M2	M1>M2*	F3>F2	–
	A2>A3	–	–	–	**F6>F2**	–
	A2>A4	–	–	–	–	–
	A3>A4	–	–	–	–	–

Note) [Age] A1: below 20, A2:20~40, A 3: 40~60, A4: above 60 years
[Marital status] M1: Single, M2: Not single
[Family type] F1: live alone, F2: couple, no children yet, F3: family group containing parents and child(ren), F4: three generations from grand-parents to children, F5: couple, children already left home, and F6: in shared accommodation or hostel.
Blank cells: no significant differences, *: difference significant at 5%, all other cells at 1% significance.

Figure 6-9 is included to assist interpretation of Table 6-5. Average values computed according to age groups for samples for the five cities from Japan are shown in Figure 6-8. There are fluctuations in average scores for statements (a) to (e), but Table 6-5 has shown that these differences are not statistically significant for any of those statements (in surveys in Japan). Average scores for statements (f), (h) and (j) are relatively spread out, giving opportunity to yield scores significantly different among the age groups. Figure 6-8 shows that for statement (f), the lowest average score is given by the sample for the lowest age group and the highest average score is provided by the oldest age group. For that statement, the average scores were increasing in value with the increase in age group. Methodology followed in Table 6-5 has taken into account the dispersion of data in each sample in a statistical meaningful manner to locate instances where we can be confident of the existence of a meaningful difference between computed average values.

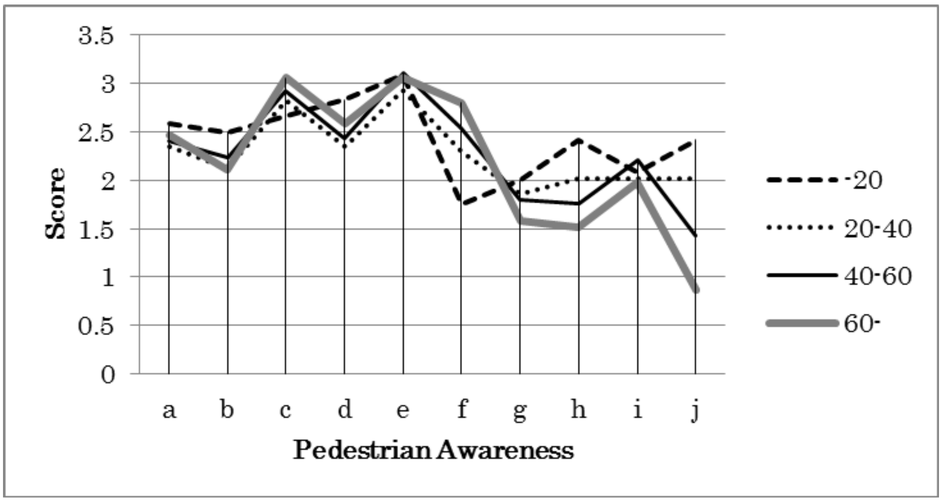


Figure 6-9 Average scores for opinion statements from pedestrians of the five cities in Japan

Figure 6-10 provides corresponding graphs for data from Sydney. In general, scores in Sydney are larger (more positive) than those in Japan. Also, it can be seen that scores of the 40-60 age group in Sydney maintains the highest score for most statements. Also, groups less than 20 years old and above 60 years old tend to score lower than other groups. Although these graphs appear to be somewhat spread out, differences of scores for a given opinion statement is significant only for a limited number of statements, and only between selected number of age groups as shown with the statistical analysis reported in Table 6-5. It is helpful to refer to Figures 6-8 and 6-9 when making interpretations related to statistically significant comparison identified in Table 6-5.

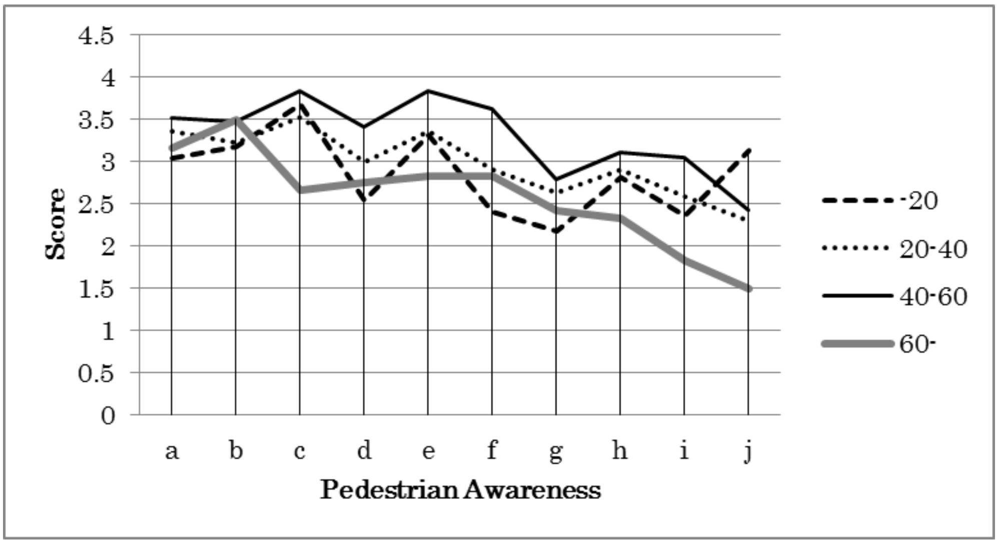


Figure 6-10 Pedestrian opinion scores (average values) for the sample from Sydney

If the graph for the age group of less than 20 old is removed from Figure 6-10, there is only few crossovers among the remaining age groups. This indicates a general tendency to provide a higher level of agreement for all opinion statements as individuals in Sydney advance from 20-40 age group to 40-60 age group. Scores from the next age group (above 60) shows the least agreement for almost all opinion statements. This characteristic is less visible in Figure 6-9 for Japan data because of many crossovers by the two graphs representing the lowest and largest age groups. Scores from the above 60 age group show the least agreement for majority of opinion statements.

Note that the sequence of age groups for the average values reported to the statement (f) is completely opposite to the sequence of averages reported for statement (h), in Figure 6-9 prepared from surveys in Japan. Statement (f) is related to the preference for good environment of the walking paths whereas statement (h) is related to the preference for the shortness of pedestrian paths in terms of distance. In other words, the youngest sample prefers the short route, but as they progress through different stages of life, pedestrians change to prefer pleasant surrounding for walking paths. At the same time, pedestrians in advanced stages of life reduce their preference toward shortness of the pedestrian paths. However, this pattern has not been reproduced in the Sydney sample in a statistically significant manner. For the purpose of this survey, in statement (f), the meaning of what is meant by a good environment of road is left for the respondent to decide. It has not been attempted to define this term from the point of view researchers to let the respondents work on the basis of what they consider as characteristics of a good surrounding.

Statement (j) is about whether respondents are signal violators as pedestrians. The presence of a statistically significant difference is evident according to all three indicators (age, marital status and type of family) of stage of life as shown in Table 6-5. In general, lower age groups are more likely to ignore traffic signals when there is no traffic. Interestingly, three age groups have provided an average value less than 2, indicating majority disagreement with the statement in samples from Japan, whereas only one age group has reported an average value below the neutral level in the Sydney sample (see Figures 6-9 and 6-10).

6.4.2 Comparisons with Indicators such as Occupation and Length of Residency

As mentioned earlier in discussions related to Figure 6-8, the length of residency may have some validity as a stage of life indicator. A person who has lived a long time in a city is likely to be in an advanced stage of life. It can be also speculated that the type of occupation may have a potential use as a stage of life indicator under certain conditions. Arguably, a student is likely to be in an early stage of life compared to an employed person. The validity of using these respondent characteristics as stage of life indicators is not well established because of the difficulty of identifying subcategories that could well correspond to stage of life of the individual. Therefore, analysis for these two indicators is presented separate from the other indicators discussed in the previous section. Table 6-6 provides a list of comparisons made using the statistical method mentioned earlier from the point of view of these additional indicators related to stage of life.

Table 6-6 shows that respondents in different occupation categories have different opinions about walking and pedestrian facilities. There are more occasions of significant differences within samples from Japan compared to samples from Sydney. In comparison of occupation subcategories, the general pattern is $O_i > O_j$ when $i < j$ according to the category. The variable residency period has provided only limited number of instances where there is a significant difference.

The pattern observed in Table 6-6 is consistent with sequences observed previously with the 'Age' columns in Table 6-5. For example, consider the statement (j) (signal violator) in Table 6-5. The sequence of entries indicates that lower age groups have consistently given a score greater than senior age groups. Table 6-6 reinforces those findings by indicating that students and unemployed (generally representing low age groups) have similar differences of opinion about walking compared to those employed (generally representing advanced age groups).

Table 6-6 Comparisons made using employment and residency period as stage of life indicators

Statement	Occupation		Residency period	
	Japan	Sydney	Japan	Sydney
(a) I like walking	O1>O4			
(b) Walking is smart	O1>O6* O5>O6*	OS1>OS2		
(c) Willing to walk a short distance daily				
(d) I like a leisurely walk		OS1>OS2*		
(e) Prefer good scenery en-route		OS1>OS2*		
(f) Prefer good neighborhood en-route			S4>S3	S5>S3*
(g) Prefer busy route				
(h) Prefer the shortest route	O3>O2* O3>O5 O3>O6			
(i) Fast walker	O1>O4 O1>O6 O2>O4 O2>O5 O2>O6			
(j) Regular signal violator	O1>O5 O1>O6 O2>O5 O2>O6 O3>O4 O3>O5 O3>O6 O4>O6*		S4>S5 S3>S4 S2>S5*	

Note:
[Occupation – in surveys in Japan] O1: Company employee, O2: National or local government employee, O3: student, O4: part time employee, O5: housewife, O6: unemployed (in the case of Japanese cities), and
[Occupation – in surveys in Sydney] OS1: employed, OS2: student (only two categories)
[Residency period] S1: less than 1 year, S2: 1~5 years, S3: 5~10 years, S4:10~20 years, 5: above 20 years.
Blank cell: no significant differences, *: difference significant at 5%, all others at 1% significance.

6.5 Conclusions

This chapter focused on describing a methodology suitable for analysis of opinions and requirements related to pedestrian facility planning according to different stages of life of users. The first part of the chapter was based on surveys conducted during 2004 – 2008 period in 21 cities spread over Japan, Taiwan and South Korea. This first part used age as a proxy indicator of stage of life.

The second part was based on surveys carried out later to address the criticism that age is only one variable and may not sufficiently encompass the definition of stage of life. The relevant surveys were carried out in 5 cities in Japan and Sydney Australia.

The questionnaire survey provided the opportunity for respondents to reveal their opinions toward ten aspects of walking and pedestrian facilities. Also, five different variables such as age, marital status, family type and period of residency in the present city have been included in the questionnaire as indicators of stage of life. Statistical methods have been applied to analyze multiple pairings of subgroups of survey samples.

Comparing the results in section 6.2 in which “age” was adopted as the proxy indicator for “stage of life” and results in section 6.4 where the correlations between different indicators for stage of life were discussed, it has been possible to establish the robustness of “age” to represent the stage of life in the context of opinions related to walking activities although age was introduced initially to the analysis as a proxy variable.

A particular finding of research interest from opinions expressed by the respondents in Japan is that one age group prefers shortness of pedestrian paths and another group prefers the path to be located in a pleasant urban environment. Preference for the shortness of pedestrian paths in terms of distance becomes less important as individuals pass through different stages of life. On the other hand, “preference for good environment of walking path” becomes more important for individuals as they progress through stages of life. However, this pattern has not been reproduced in the Sydney sample in a statistically significant manner. Nevertheless, this indicates the importance of understanding the role of regional characteristics in dealing with these relationships. In any case, further research is required to adequately explain what respondents meant by terms such as shortest path and paths with good environment.

Another finding that is of interest to regulators and road authorities is related to signal violations by pedestrians. Firstly, data reveals such violations to be a common phenomenon. Also, data analysis has shown that the propensity to ignore signals varies with the age group of the pedestrian. This indicates the importance of knowing site specific demographics of pedestrians using the road in addition to demand counts collected for traditional method of engineering design for pedestrian crossing sites.

The core sections of this chapter, i.e. sections 6.3 and 6.4, covered five Japanese cities and Sydney which has different historical and cultural backgrounds. The relationships between stage of life and the pedestrian opinion statements in Japan are more distinct than those in Sydney. It is also noted that the scores for each opinion statements in Sydney have been relatively high irrespective of stage of life, compared to Japan. Further investigations may be required to explain these properties.

Chapter 7. Effect of Lifestyle on Pedestrian Attitudes

7.1 Relevance to prev

ious chapters

Whereas stage of life was considered in Chapter 6 as the *sociological property* that influences the *pedestrian attitudes*, this chapter focuses on *lifestyle* as the relevant variable. In that sense, this chapter presents a different connection between *sociological properties* and *pedestrian characteristics* shown in the conceptual framework shown in Figure 2-1.

The aim here is to continue with the analysis of the impacts of sociological properties using variables that represent life style. The range of variables we could use includes gender, age, car ownership, public transport usage, location of residence relative to public transport facilities. The access distance to public transport systems, separately for bus and railway systems, was available from the questionnaire survey described earlier. The access distance available could be referred to perceived walking time as we have not attempted to verify the stated walking time.

For the purpose of the present analysis, lifestyle is determined by the type of transport used by individuals and where they live. The type of transport use is determined by public transport usage and car-ownership. Two ways for measuring public transport use is available according the data collected, and will be explored in the next section. The other aspect, (i.e. where the individual lives) cannot be pinpointed to a microscopic level according to the data available. However, there is an opportunity to use the size of the city where the individual lives as a rough indicator for life style as identified by the residential location. The approach followed in this chapter adopts "public transport usage" and "residential location preference" as key lifestyle indicators. Indeed, these indicators could be related to the stage of life as well.

7.2 Public transport user counts

7.2.1 Public transport users and non-users

It was possible to compute a magnitude for the level of public transport usage from the surveys by focusing on the frequency of public transport use reported by respondents. We will make use of that measure in the next section.

A different kind of measure is also available as it was it was possible to make a binary classification of respondents as users and non-users of public transport. During the questionnaire preparation the threshold frequency to be classified as a public transport user was set as using bus or train once a month. In other words, a person who does not use public transport even once a month was deemed a non-user. It is arguable whether 'once month' is a too low threshold value to describe a public transport user.

The percentage distribution of public transport users according to the data collected is shown in Figure 7-1. This figure is based on data from the 10 cities covered in stage 1 surveys in Japan and cities in Taiwan and South Korea in stage 2 surveys described in Chapter 3.

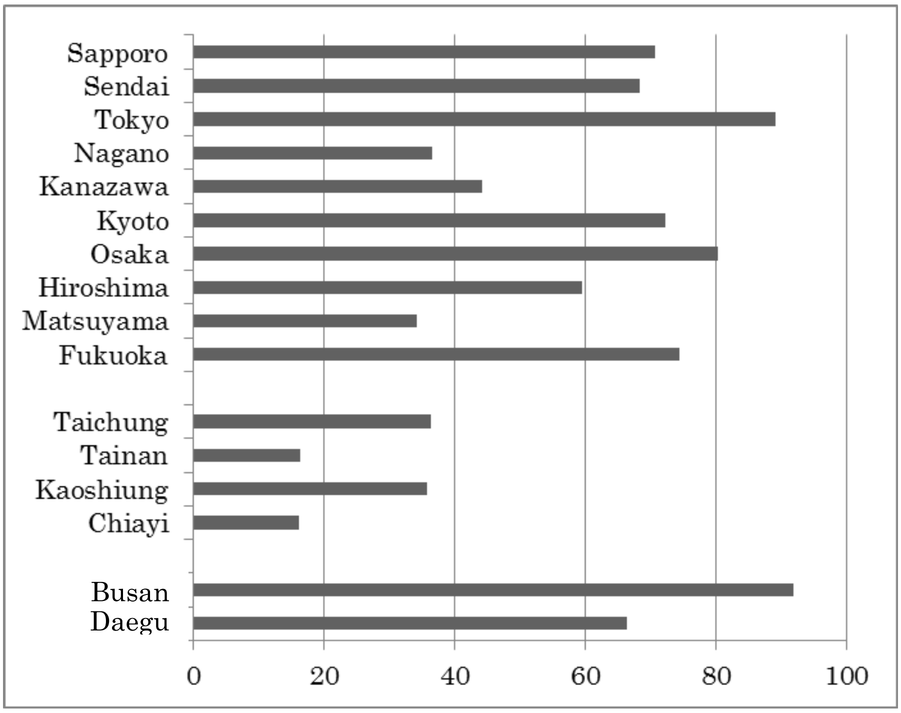


Figure 7-1 Public transport user quantity of respondents in each city

According to Figure 7-1, in one city (from South Korea), the proportion of public transport has been greater than 90%. Cities in Japan have provided the largest spread of the user counts and the corresponding values vary from approximately 33% to 90%. The percentage of public transport users in Taiwanese cities surveyed were at relatively low levels.

7.2.2 General attitudes of public transport users in Japan toward walking

General attitudes toward walking observed through statements (a) through (d) are examined using the statistical method mentioned in previous chapters to find out whether there are differences that can be associated with pedestrian attributes or attributes of city or type of city where the respondents live. Table 7-1 shows results of the non-parametric variance analysis for statements (a) to (d). As in a previous chapter, when there is a statistical difference between scores, the sample with higher score is reported first and the lower score sample is stated second (with a greater than sign separating them) in this tabulation. For example, for statement (a), public transport usage showed a statistically significant difference. The second row states 'User > non-user' indicating that those who use public transport (at least once a month) reported a statistically significant higher score than others.

Variables reflecting transport usage show some interesting results. For example, car ownership has no meaningful effect on attitude toward walking. For the purpose of analysis the respondents were separated to two groups 'owners' and 'non-owners' based on the response to the yes-no question about car ownership (question 8 of the questionnaire). Although there were some numerical differences in average scores between owners and non-owners, the difference has failed the statistical significance test explained earlier.

But the public transport usage has shown an impact for three of the statements presented.. Recall that this analysis has counted a person using train or bus at least once a month as a public transport user. Therefore, according to Table 7-1, respondents who use public transport at least once a month have a positive attitude toward walking compared to others.

Table 7-1 General attitude toward walking

	(a) I like walking	(b) Walking is smart	(c) Willing to walk a short distance daily	(d) I like walking for leisure
Car ownership	None	None	None	None
Public transport usage	User > non user	None	User > non user	User > non user
City size	None	None	Pop 1-1.5 mil > pop below 1 mil	None

Note: Differences where shown are significant at 1% level.

Last row of Table 7-1 shows the impact of the size of the city where respondents live on their attitudes. Here the size of the city is adopted as an indicator of the level of urbanization and the associated lifestyle of the individuals. The population counts for the cities surveyed were shown previously in Table 3-4. Cities surveyed were separated into three groups, those with less than 1 million population, those with a population between 1 and 1.5 million and those with a population greater than 1.5 million. There were 8, 4 and 3 cities respectively in each size category. Table 7-1 does not show much influence of the size of the city where respondents live on their attitudes towards walking except for the statement (c) about willingness to engage in some walking on a regular basis.

7.2.3 Character of preferred of routes for walking and signal violation habits

Statements (e) through (h) of the survey represent preferences taken into account in route choice. The size of the metropolitan area has more occurrences of significant differences (see Table 7-2) with these preference statements than with attitude statements discussed in the previous section. In general, residents in larger cities show more positive responses for preference statements (e) and (g).

Also, even once a month usage of public transport affects route choice preferences, whereas this attribute did not play a major role earlier with general attitudes toward walking. Car ownership provided significantly different results with only one preference statement, car owners showing a greater dislike to walking on crowded pedestrian facilities.

Table 7-2 Preferences related to route choice

	(e) Prefer good scenery en-route	(f) Prefer good neighborhood en-route	(g) Prefer busy routes	(h) Prefer shortest route
Car ownership	None	None	Non owner > owner	None
Public transport usage	User > non user	User > non user	User > non user	None
City size	Pop above 1.5 mil > pop 1-1.5 mil Pop 1-1.5 mil > pop below 1 mil	None	Pop above 1.5 mil > pop below 1 mil	None

Note: Differences where shown are significant at 1% level.

The walking behavior attributes considered in the survey are stated relative walking speed and pedestrian signal compliance. Table 7-3 shows comparison of results obtained from analysis of these stated reflections of walking behavior of respondents. Analysis of the statement (i) that related to walking speed shows there is no significant difference observed between cities of different sizes. All three attributes considered in this analysis has shown statistically significant differences for the statement that related to signal compliance.

Table 7-3 Signal compliance behavior of pedestrians

	(i) Fast walker	(j) Regular signal violator
Car ownership	Owner > non owner	Owner > non owner
Public transport usage	None	User > non user
City size	None	Pop above 1.5 mil > pop 1-1.5 mil Pop above 1.5 mil > pop below 1 mil

7.2.4 Comparison of attitudes of public transport users in relation to the three countries

Table 7-4 shows results of the comparison study performed by separating the database to three samples according to the country of respondent. The analysis process here is rather simple, achieved by adding 10 city samples from Japan into one group; 4 cities from Taiwan into one group and 2 cities from South Korea into the third group. Then the statistical analysis method mentioned earlier in chapter 3 has been reapplied.

To reduce complexity, the comparison made here has been focused on those who were classified as users and non-users of public transport. Table 7-4 has 'User' as the lead label in all comparisons. When the score of this group is lower than that of the non-user group, bold font is selected to highlight direction of the inequality symbol. In Japan, public transport users have generally more positive attitudes (as indicated by (a) through (d) in the statement list) toward walking compared to those who do not use regular public transport services such as trains and buses. Implication of this observation is different for different cities as some cities have a high percentage of public transport users (example – Tokyo) and others may have a large proportion of non-users (examples: Nagano and Matsuyama).

Comparison of data from Taiwan for attitude statements shows a reversal of the direction of the inequality symbol, indicating that non-users have provided a higher score than users for two of the indicators (see rows (a) and (b) in Table 7-4). Recall that it is statements (a) to (d) that are referred to as attitude statements in this work. Therefore, results for South Korea also has two such indicators where non-users of public transport have provided the higher average score (see rows (a) and (c) in Table 7-4). Although it is not possible to provide a definitive reason for these changes of behavior from different countries according to the lifestyle variable, these results indicate the importance of considering pedestrian system development in the context of the local pedestrian travel culture.

Pedestrian preferences and stated behavior (see (e) through (j) in the statement list) are also relatively more positive for public transport users according majority of indicators considered in Table 7-4 for respondents from Japanese cities. Taiwan samples have shown a significant difference for only one indicator in this group of comparisons. That is for agreement with propensity to violate pedestrian traffic signals when crossing a street (row (j) of Table 7-4). Similarly, only one indicator in this group provided a significant difference in the Korean study. It is interesting to note that the Korean sample of public transport non-users has provided a relatively higher score, which is different from the direction of inequality that was observed in Japan and Taiwan.

Table 7-4 Comparison of attitudes toward walking according to usage of public transport

	Japan	Taiwan	South Korea
(a) I like walking	User > non user	**User < non user**	**User < None user***

(b) Walking is smart	-	**User < non user**	User > non user*
(c) Willing to walk a short distance daily	User > non user	-	**User < None user**
(d) I like a leisurely walk	User > non user	User > none user*	-
(e) Prefer good scenery en-route	User > non user	-	-
(f) Prefer good neighborhood en-route	User > non user	-	-
(g) Prefer busy routes	User > non user	-	**User < None user***
(h) Prefer shortest route	-	-	-
(i) Fast walker	-	-	-
(j) Regular signal violator	User > non user	User > none user*	-

Note -indicates failure to show a statistically significant difference. * indicates inequality is significant at 5%. All others have an inequality significant at 1%.

Anyhow, as public transport users in Japan has shown a preference for improved pedestrian amenities, it can be argued that efforts to establish quality public transport systems with integrated pedestrian facilities are logical planning directions that would receive public support. However, dealing with implications of the preference comparison of South Korea would be more challenging. There, improved pedestrian facilities may not be a priority for public transport users. It is also important to review the survey methodology followed that may provide an explanation for the results. The Korean survey was administered during classes held for driving license renewal and therefore the survey respondents could have a history of above average motor car dependence. This may have introduced a sample bias in representation of views toward public transport and walking. On the other hand, the low level of pedestrian network connectivity observed by some commentators in South Korea may be a reflection of the lack of public support indicated from results shown in Table 7-4.

7.3 Impact of other indicators of lifestyle

7.3.1 Lifestyle indicators

'Lifestyle' has a variety of meanings as indicated in Section 7.1. This project has drawn from concepts presented by Kitamura (2009) in relation to indicators that reveal a person's lifestyle. For transport research purposes, lifestyle is a reflection of income, expenditure, employment, car ownership and availability of a valid driving license. Therefore, lifestyle questions were classified into three broad areas in this study. The first two questions in the following list focused on transport mode usage, the next three questions covered lifestyle preferences and the last three questions involved non-transport activity patterns of respondents. These questions were derived from parts 1 and 2 of the questionnaire explained in section 6.3.1 (see Figure 6-1). Words shown within brackets at the end of each line are used later in the analysis to refer to these variables:

(1) Frequency of public transport usage in a month (PT)

(2) Frequency of private car usage in a month (Car)
(3) Preference to conduct an environmentally friendly life (Environment)
(4) Preference to live in central part of the city (City center)
(5) Preference to live in a convenient location with an acceptable living environment (Convenience)
(6) Participation in activities to maintain good health (Health)
(7) Participation in volunteer activities (Volunteer)
(8) Participation in out-door activities (Out-door)

Respondents were asked to state “More than once a month” or “Less than once a month” for questions (1) and (2), and “Yes” or “No” for questions (3) through (8). Frequency of more than once a month was considered sufficient to classify the level of use of the particular mode as high. Frequency less than once a month is considered as a low level usage in the following analysis.

7.3.2 Relationship among lifestyle indicators

A methodology known by names of “Hayashi's quantification method type III” (Hayashi (1974)) and “Correspondence analysis” can be applied now as shown in Figure 7-3 to identify grouping of lifestyle variables with similar properties in relation to attitude statements presented to respondents. This method is similar to the principle component analysis technique mentioned in section 4.4. Generally, the principle component analysis is suitable for continuous data and correspondence is applied for categorical data. This family of methods display internal structure of the data in a two dimensional form.

Scanning along horizontal axis of Figure 7-3, it can be seen that high usage of public transport and low usage of car are located in the positive area, the first quadrant. The opposite, low public transport usage and high car usage are located in the negative area (the third quadrant). It is also interesting to note that high level of public transport usage and preference of living near the city center are closely located. On the other hand, scanning along the vertical axis, ‘Yes’ for activities for maintaining good health, volunteer activities and environmentally friendly life are located on the positive side of the axis, and ‘No’ for these questions are located in the negative side. Also, ‘Yes’ for out-door activities and high usage of car are located close to each other in an area where both axes are in negative values (third quadrant), and ‘No’ for the two lifestyle questions are located close to each other in the all positive quadrant. These observations indicate that inner city living is more conducive to or in harmony with a public transport oriented community.

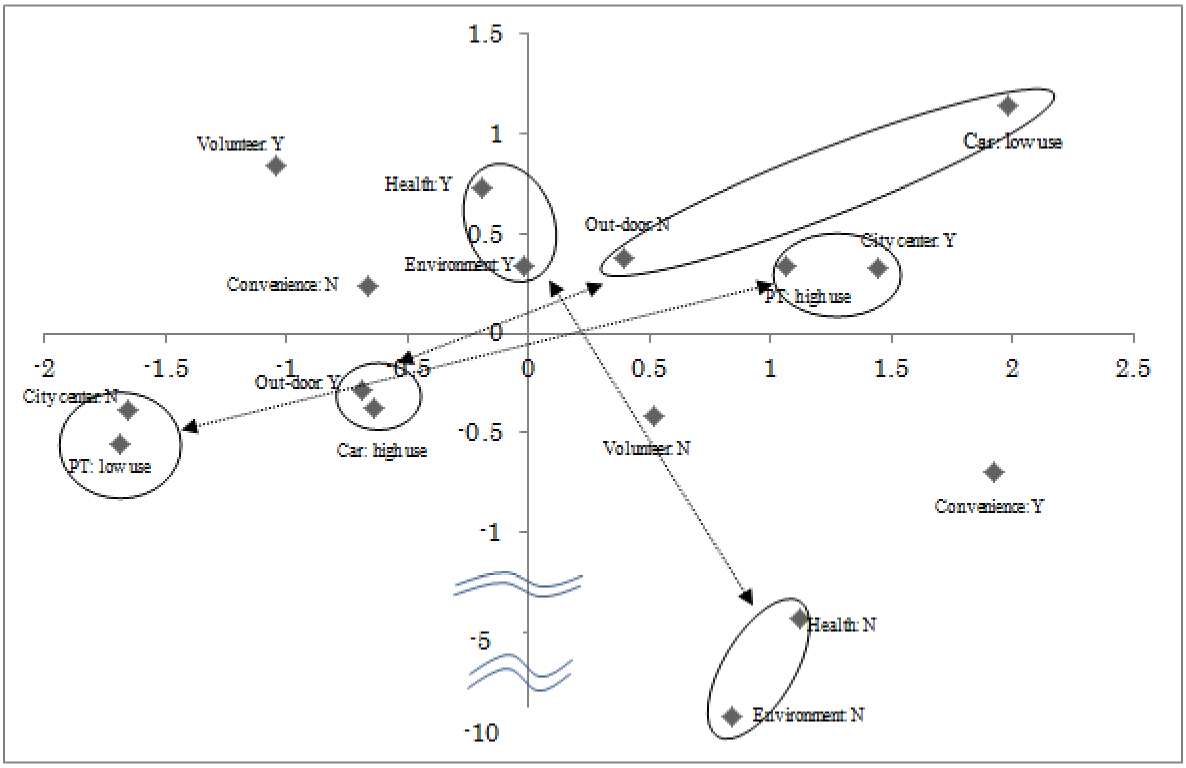


Figure 7-3 Correspondence analysis related to lifestyle indicators

Groupings identifiable in Figure 7-3 for pairings of variables indicate three useful connections. Firstly, *frequency of public transport usage* (lifestyle indicator 1 in this survey) and *preference to live in the city center* (indicator 4) have a relationship. Also, *participation in out-door activities* (indicator 8) and *frequency of car usage* (indicator 2) are related indicators. In addition, *preference for an environmentally friendly lifestyle* (indicator 3) and *participation in activities for good health* (indicator 6) are closely related. These pairs have been already identified by circles around them from the correspondence analysis output graph already shown as Figure 7-3. Relationships identified here will be useful later for a discussion on formulation of planning guidelines related to pedestrian facilities.

7.3.3. Relationships between lifestyle and pedestrian attitudes

This section extends the preceding observations with a statistical analysis. Table 7-5 summarizes results from the standard statistical analysis using Kruskal-Wallis test and Bonferroni method (Siegel and Castellan (1988)) mentioned earlier. In this tabulation, the eight lifestyle indicators are in columns and the 10 attitude statements are in rows. JPN refers to the sample containing all respondents from the five cities in Japan covered in stage 3 surveys. SYD refers to sample containing Sydney responses. In many SYD columns there are no entries indicating a lack of statistically significant difference among the two samples (Yes and No or

High and Low responses) compared. For Sydney, only variable 3 which refers to environmentally friendly lifestyle has provided results of statistical merit. For Japan data, lifestyle indicators 1, 6, 7 and 8 have yielded statistically valid differences of response scores particularly with pedestrian attitude and preference statements (a) to (f).

Table 7-5 Relationship between attitude statements and lifestyle indicators

Opinion statements	Lifestyle indicators															
	(1) PT		(2) CAR		(3) Envi		(4) Center		(5) Conven		(6) Health		(7) Vol		(8) Out-d	
	JPN	SYD	JPN	SYD	JPN	SYD	JPN	SYD	JPN	SYD	JPN	SYD	JPN	SYD	JPN	SYD
(a)	M	-	-	-	-	-	-	-	-	-	Y	-	Y	-	Y	-
(b)	-	-	L	-	-	Y	-	-	-	-	Y	-	Y	-	Y	-
(c)	M	-	-	-	-	-	-	-	N	-	Y	-	Y	-	Y	-
(d)	M	-	-	-	-	Y	-	-	-	-	Y	-	Y	-	Y	-
(e)	-	-	-	-	Y	-	-	-	-	-	Y	-	Y	-	-	-
(f)	-	-	-	-	Y	Y	-	-	-	-	Y	-	Y	-	-	-
(g)	M	-	L	-	-	Y	Y	-	Y	-	-	-	-	-	-	-
(h)	-	-	-	-	N	-	-	-	Y	-	N	-	-	-	-	-
(i)	M*	-	-	-	-	-	-	-	-	-	-	-	Y	-	Y	-
(j)	M	-	-	-	N	-	Y	-	-	-	N	-	N	-	-	-

Note) JPN: Japan, SYD: Sydney
M:Frequency above once a month is significantly greater than frequency below once a month
L: Frequency below once a month is significantly greater than frequency above once a month
L and M are applicable to lifestyle indicators (1) and (2) only.
Y and N are applicable to lifestyle indicators (3) through to (8).
Y:'Yes' response is significantly greater than 'No' response
N:'No' response is significantly greater than 'Yes' response
-: no significant difference, *: 5% significance, others: 1% significance

7.4 Relevance to lifestyle favoring public transport use

7.4.1 Public transport usage

Figure 7-3 in section 7.3.2 has shown that the ability to pair transport mode focused lifestyle measures with other lifestyle measures. This suggests that the preference of transport mode is a reliable indicator of the lifestyle of a person for pedestrian behavior analysis. It should be noted that the following analysis is based on those who stated that they have used public transport at least once during the last month. It is acknowledged that selection of once a month as the threshold is arbitrary and coarse. However, the decision to select that criterion was made to reduce the complexity of the survey and the unacceptably associated with a high level of workload to respondents with alternative question structures considered. Anyhow, this conservative classification is based on the argument that it is impossible to call someone a public transport user if that person has not used public transport at least once during last month.

Figure 7-6 shows the public transport user and non-user proportions in the cities surveyed. According to this graph, majority of respondents in Tokyo, Osaka, Sapporo, and Sydney can be termed as public transport users. On the other hand, majority of citizens in Matsuyama and Urazoe are non-users of public transport even with the conservative criterion of naming users as those who use public transport at least once a month. Henceforth, we call the former group as cities with high usage of public transport, and the latter two as cities with low usage of public transport. A characteristic of high usage cities is that they all have well developed public transport systems. In comparison, cities with low usage of public transport have only a rudimentary system at early stages of evolving into a useful transport solution able to cater for public needs. Based on that observation, it is possible to view Figure 7-4 as a diagram indicating the level of service provided by existing public transport arrangements of cities covered during surveys.

Figures 7-1 to 7-4 have revealed that there is a difference between attitudes of residents who use public transport more than once a month and those whose public transport less than once a month. According to those studies, residents in a city where public transportation system is well developed have a positive image toward walking. On the other hand, those who live in a city with poor public transportation do not have such a positive image about walking (Tsukaguchi, et al., 2011).

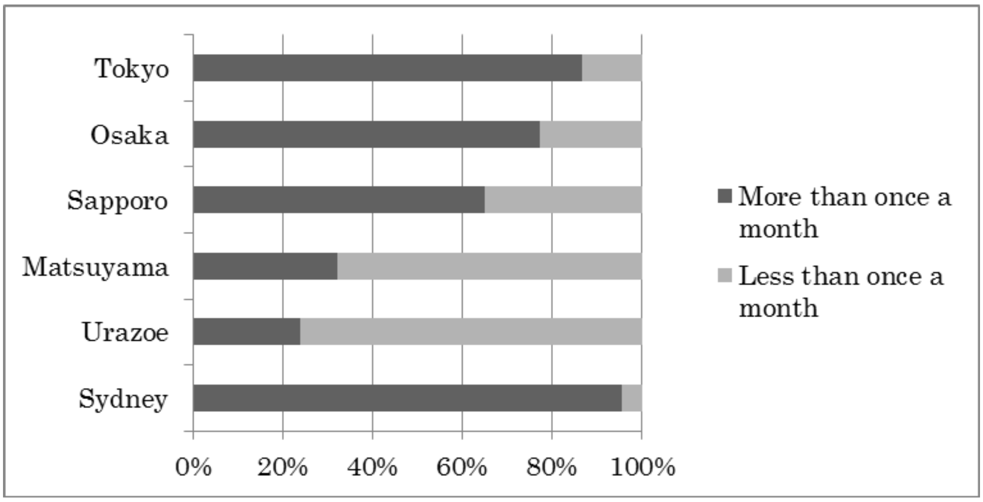


Figure 7-4 Public transport usage in cities surveyed

Figure 7-5 compares average scores of pedestrian opinions by high usage and low usage cities of public transport. In general, average scores in high usage cities of public transport are higher than those of low usage cities. In particular, average scores for statements (a) through (d) in high usage cities of public transport are higher than those in the low usage cities. This means that residents in urban centers with the high usage of public transport have a more favorable view about walking than citizens in the other group of cities. It may be interesting to note that in the former group, citizens are often traffic signal violators. Statements (e) and (f) related to walking environment have a trend different from the other opinion statements. Scores in the low public transport usage cities are larger than in cities with good public transport.

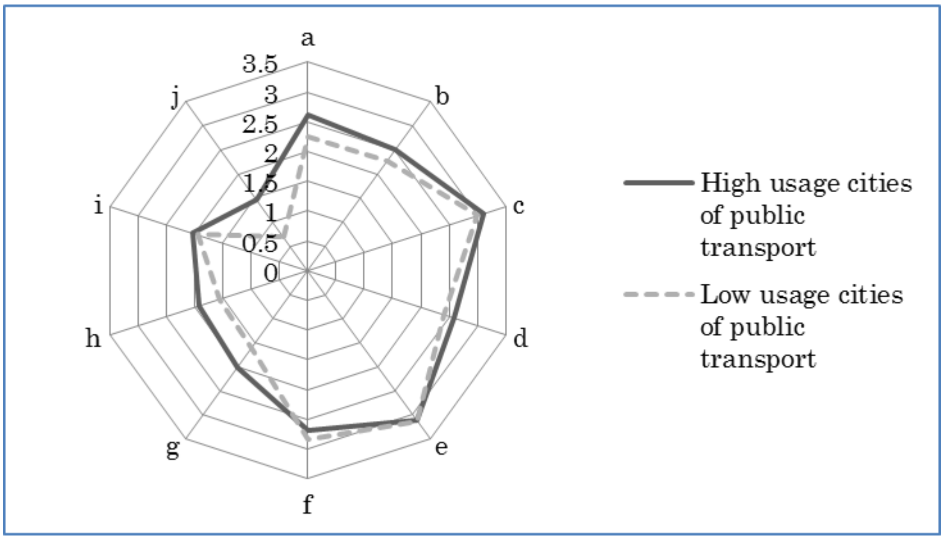


Figure 7-5 Comparison of average scores from opinion surveys

Kruskal-Wallis test has been applied again to investigate statistical validity of the above comparisons. The results are presented in Table 7-6 using the same convention as explained for Table 7-5. 'User>Non user' means that the average score given by public transport users is larger than the score given by those classified as non-users for that particular opinion statement. In high usage cities, public transport users provided higher average scores than low usage cities for all statements. This means users are more positive than non-users toward each opinion statement. For (e) and (f) the statistical significance is less strong but still acceptable. On the other hand, statistically significant differences were not found in low usage cities. Table 7-6 indicates that the effect of public transport usage on pedestrian opinions is significant in cities with high level of public transport usage. Numerical values related to statistical analysis and t-statics are not shown in the tabulation to keep the focus on final outcomes.

Table 7-6 Statistical differences by frequency of public transport usage

Pedestrian opinions \ Lifestyle	Frequency of public transport usage	
	High usage cities	Low usage cities
(a) I like walking	User>Non user	-
(b) Walking is smart	User>Non user	-
(c) Willing to walk a short distance daily	User>Non user	-
(d) I like a leisurely walk	User>Non user	-
(e) Prefer good scenery en-route	User>Non user*	-
(f) Prefer good neighborhood en-route	User>Non user*	-
(g) Prefer busy route	User>Non user	-
(h) Prefer shortest route	User>Non user	-
(i) Fast walker	User>Non user	-
(j) Regular signal violator	User>Non user	-

Note) -: no significant difference, *: 5% significance, others: 1% significance

7.4.2 Preference of residential location

Analysis of responses to questions related to preferred residential location is presented now. These questions were referred to as lifestyle indicators 4 and 5 in a previous section. The first indicator was whether inner city living was preferred. The second indicator was whether convenience (where the word convenience is left to the personal interpretation of the respondent) was preferred in residential location selection. Figure 7-6 shows that majority of citizens who live in, Tokyo, Osaka, and Sydney prefers living in the city center. Sapporo shows an even split with those who prefer and not-prefer being approximately equal in numbers. The remaining two cities Matsuyama and Urazoe have a majority not wishing to live at the city center. Note that the last two cities were previously identified to be cities with low usage level of public transport. This indicates that the preference to stay near the city center is correlated to the level of public transport usage observed in the city.

Figure 7-7 shows a marked difference between Sydney and cities in Japan about the lifestyle based on living at a convenient location. Only less than 30% of respondents in each of the five cities surveyed in Japan indicate a preference for a convenient residential location. It was not possible to articulate a generally acceptable definition in simple words in a manner acceptable to the range of different cities surveyed. In other words, it is acknowledged that this research team is unable to state what respondents meant as a “convenient location”. Among these cities, the two cities with low usage of public transport have shown the corresponding value to be even lower at less than 20%. It is difficult to explain this result without follow up surveys to understand the full spectrum of considerations addressed by citizens in determination of residential location. It is speculated that this result may be an outcome of respondents considering additional priorities such as living environment during residential location selection.

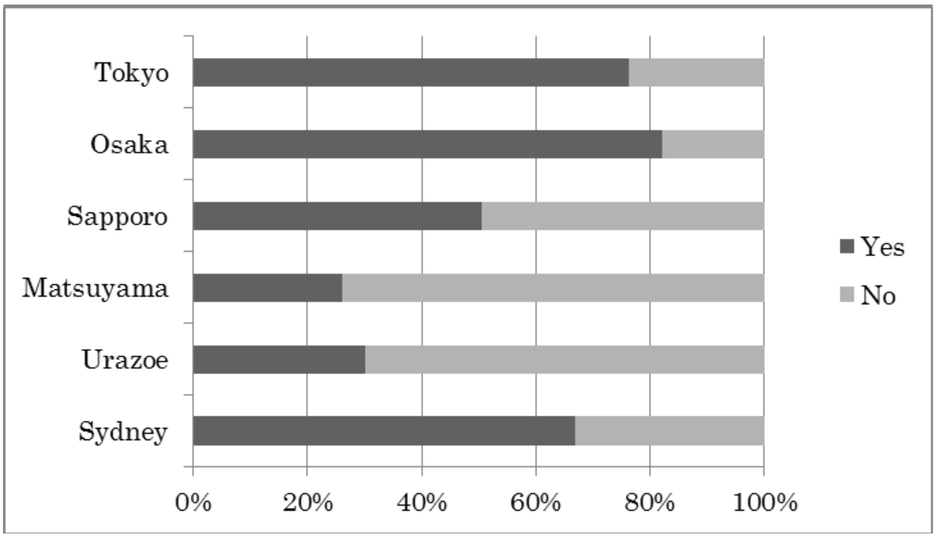


Figure 7-6 Percentage of preferences to live at the city center

In Figure 7-7, for Sydney, the "Yes" and "No" breakdown is approximately equal. Again it is difficult to interpret these results without follow up surveys. Clearly, there is a difference about the quantity of this lifestyle measure in the two countries. It can be only speculated that it may be a result of properties of the built environment options available to citizens. Also, the difference between the two countries may be a manifestation of differences of the survey methods applied as explained in a previous section. Majority of respondents in Japan were in the above 60 age group whereas the bulk of Sydney sample was in the 20 - 40 age group. The questionnaire recorded the age group of respondent in three 20 year steps till 60 years of age and a final group containing those above 60 years old as part of demographic information that included household, marital state and current occupation.

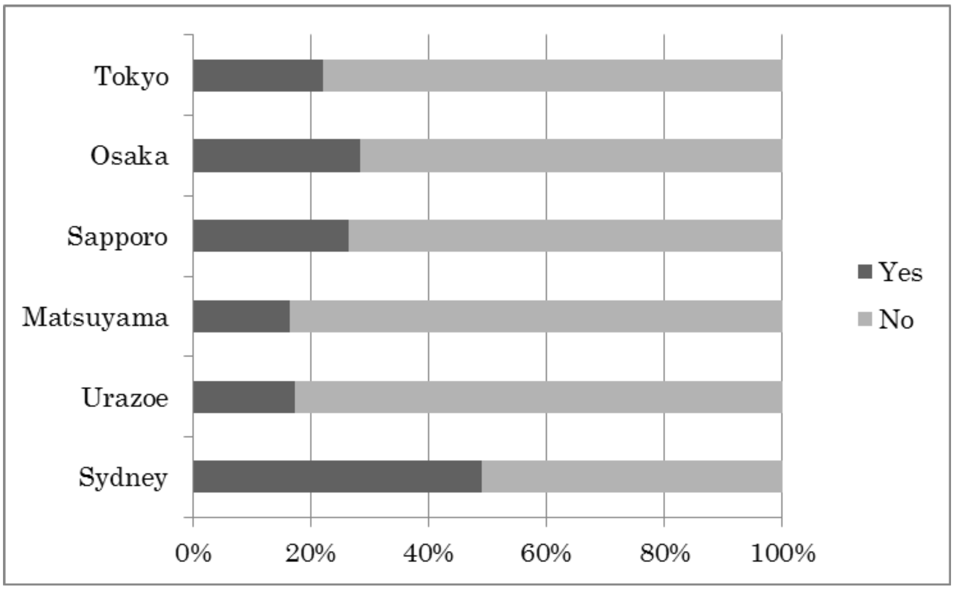


Figure 7-7 Percentage of preferences to live at a convenient location

7.4.3 Analysis based on living in a city with high or low usage level of public transport

Nonparametric variance analysis is applied again using statistical formulations mentioned earlier to identify lifestyle indicators that have an effect on pedestrian opinions in cities with different levels of public transport usage. Table 7-7 shows results where the *High* and *Low* columns refer to level of public transport usage according to the classification mentioned in an earlier section. 'Yes' in these tables means that average scores for the opinion referred in the particular row from the sample that said "Yes" to the lifestyle indicator indicated by the column title is greater than the average score from "No" answers to that lifestyle indicator. This difference was statistically valid at 1% significance level for majority of situations. Again, numerical values related to the analysis have been skipped in tabulation to minimize the presentation clutter.

Comparing results shown on the tabulation, the effects of lifestyle indicators (6) through (8) on pedestrian opinions are different in high usage cities as well as low usage cities of public transport. In cities with high public transport activity, indicator (8) that refers to participation in out-door activities has negative effects on opinion statement (g) that refers to a preference for a busy route and statement (h) preference for the shortest route. Indicator (6) has no contribution to the first four opinion statements that referred to general attitude toward walking. On the other hand, for cities with low public transport participation, lifestyle indicator (6) that refers to maintaining good health has positive effects on pedestrian opinion statements (a), (c) and (d). It does not mean that the effect of (6) maintaining good health is not significant in cities with high usage of public transport – it is already shown in Figure 5 that the average scores are already higher than those in other cities. For the indicator (7) that refers to volunteer activities, there is a reasonable amount of similarity between patterns that have emerged in

Table 7-7 for the two columns for cities with high and low usage of public transport. In both types of cities, volunteer activity has positive effects on general attitudes toward walking (i.e. the first four opinion statements).

Table 7-7 Statistical analysis based on public transport usage of level of the host city

Lifestyle / Pedestrian opinions	(6) maintain good health		(7) volunteer activity		(8) out-door activity	
	High	Low	High	Low	High	Low
(a) I like walking	-	Yes*	Yes	-	-	Yes
(b) Walking is smart	-	-	Yes	Yes	-	-
(c) Willing to walk a short distance daily	-	Yes	Yes	Yes	-	-
(d) I like a leisurely walk	-	Yes	Yes*	Yes	-	Yes
(e) Prefer good scenery en-route	-	Yes	Yes*	Yes*	-	-
(f) Prefer good neighborhood en-route	Yes*	Yes	Yes	-	-	-
(g) Prefer busy route	-	-	-	-	No*	-
(h) Prefer shortest route	No	No*	-	-	No*	-
(i) Fast walker	-	-	Yes	-	Yes*	-
(j) Regular signal violator	No	No	-	-	-	-

Note - no significant difference, *: 5% significance, others: 1% significance

As indicated in Figure 7-5, average scores in cities with low usage of public transport are lower than those with high usage. Nevertheless, lifestyle indices (6) through (8) have effects on general attitude toward walking in cities with low usage of public transport as shown in Table 7-7 Therefore, to encourage citizens in those cities to engage in and enjoy walking, planners need to take advantage of relationships among pedestrian opinions and lifestyle indicators (6) through (8).

7.5 Conclusions

Pedestrian traffic behavior is a composite outcome of infrastructure, individual characteristics and societal attributes. Therefore, awareness of available pedestrian facilities and attitudes toward walking is likely to affect the lifestyle. Conversely, lifestyle is likely to have an impact on pedestrian behavior. This study has been conducted in order to inspect these two-way relationships.

Since lifestyle has been expressed in different ways in literature, this study has adopted eight indicators to measure lifestyle. These lifestyle indicators belong to three broad categories: public transport usage, lifestyle preferences, and non-transport activities. Initial part of the study looked into co-relationships among these lifestyle measures. There are clear connections between some lifestyle measures, for example between public transport usage and living in city center, and environmentally friendly life and maintaining good health.

A statistical analysis has been performed to capture meaningful relationships between lifestyle choices people have made and how they view walking experience. Certain lifestyles enhance the individual's perception about pedestrian facilities and walking in general, possibly because those lifestyles place some reliance on walking as a transport mode.

This chapter consisted of two part; "public transport usage" was adopted as an indicator of lifestyle in the first part to explore the general pattern of relationships. Then other indicators of lifestyle were included in the analysis in the second part.

The analysis has also shown that the level of existing public transport in the urban area has an overarching influence on these relationships. To handle this issue, this project has divided the cities surveyed into two different groups as those with high and low level of public transport usage.

Comparison of results between the surveys in Japan and Australia has shown that both samples agree that a lifestyle stated as favoring environmentally friendly style has an impact on shaping pedestrian attitudes. It is encouraging to note that contrasting countries can have a similar pattern of outcomes from adoptees of this lifestyle. Policy implications of this finding remain to be investigated. Anyhow, the project has been successful in showing that there are certain global features coexisting with regional characteristics.

Although this project has identified where relationships exist and the direction of relationship patterns, it is acknowledged that reasons for such observations are somewhat hypothetical at this stage. There are further variables covered in the study framework that could now be explored to assist further. For example, analysis from the view point of nationality, historical and cultural traits mentioned in the conceptual framework, may provide more appropriate and quantifiable explanations to observations made during the current analysis.

Chapter 8. Pedestrian Behavior based on Observation surveys

8.1 Observation sites

Analysis presented now is based on observation surveys carried out in Japan in contrast to analysis based on attitudes and personal reflections performed in previous chapters. This chapter explores relationships among three elements; regional environment, sociological properties and pedestrian properties as indicated in Table 2-1. The analysis here investigates only two measurable aspects of pedestrian characteristics, they being walking speed and pedestrian signal compliance rates.

Observed behavior of pedestrians was recorded in five cities in Japan for this purpose. The cities covered were; Tokyo, Osaka, Kyoto, Fukuoka, and Matsuyama. Observations were carried out in multiple locations within the downtown area (CBD) in each city. Maps indicating selected number of outdoor observation sites in different cities with pictorial views of sites are shown in Figure 8-1. In addition, there were number of sites located within indoor walking passages in major railway terminals as well.

Essentially, the observation sites selected were in areas known for relatively busy pedestrian activity within each city. In Tokyo, observation sites were in Ginza area (Figure 8-1a), an area popular for shopping, dining and entertainment. Similarly, in Osaka observers were sent to Umeda area (Figure 8-1b) which generates a large amount of pedestrian activity as the area serves a transport hub containing numerous shopping centers including underground shopping malls. The area selected for pedestrian observations in Kyoto was in the historical downtown area (Figure 8-1c) visited by large crowds for its cultural significance. Observations in Fukuoka were carried out in Tenjin (Figure 8-1d), known as the largest shopping district in Kyushu Island. This area has three large shopping centers and many specialty shops generating a large volume of pedestrian activity. In Matsuyama, the capital of island of Shikoku, observations were carried in the vicinity of Okaido tram stop (Figure 8-13). This area was arguably the most popular activity center in the island. No indoor observation sites were selected for surveys in Matsuyama. In other words, Figure 8-1e shows all sites selected for observation surveys in Matsuyama.

Field observations were classified according time period during the day. As explained later, four time periods were considered, as morning, lunch time, afternoon and evening. Another classification adopted for recording pedestrian data was related to gender and group size as explained in the next section.

Figure 8-1a Four of the observations sites in Tokyo (Ginza)

Figure 8-1b Two of the observations sites in Osaka (Umeda)

Figure 8.1c Six of the observations sites in Kyoto (historical town center)

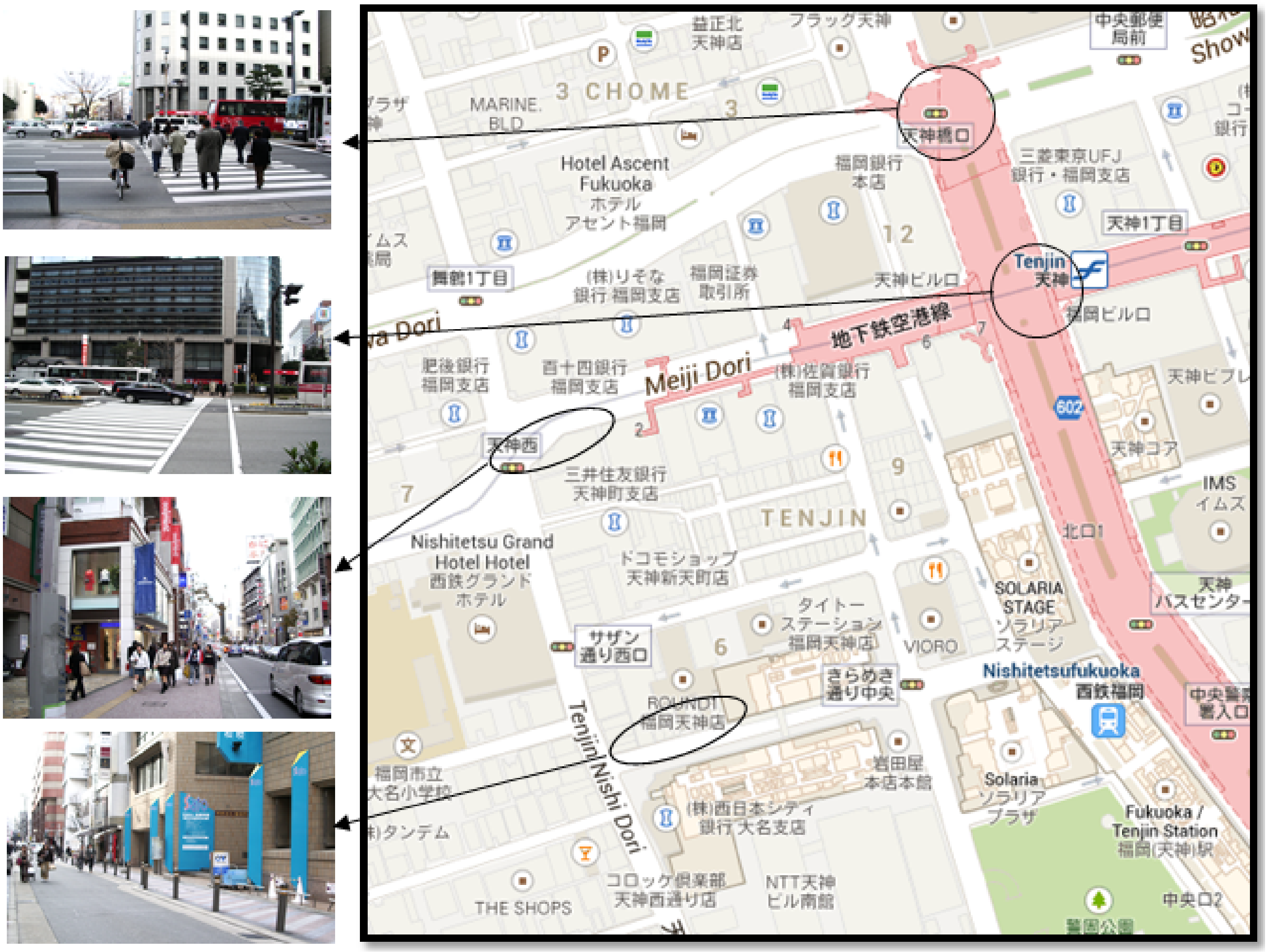


Figure 8-1d Four of the observations sites in Fukuoka (Tenjin)

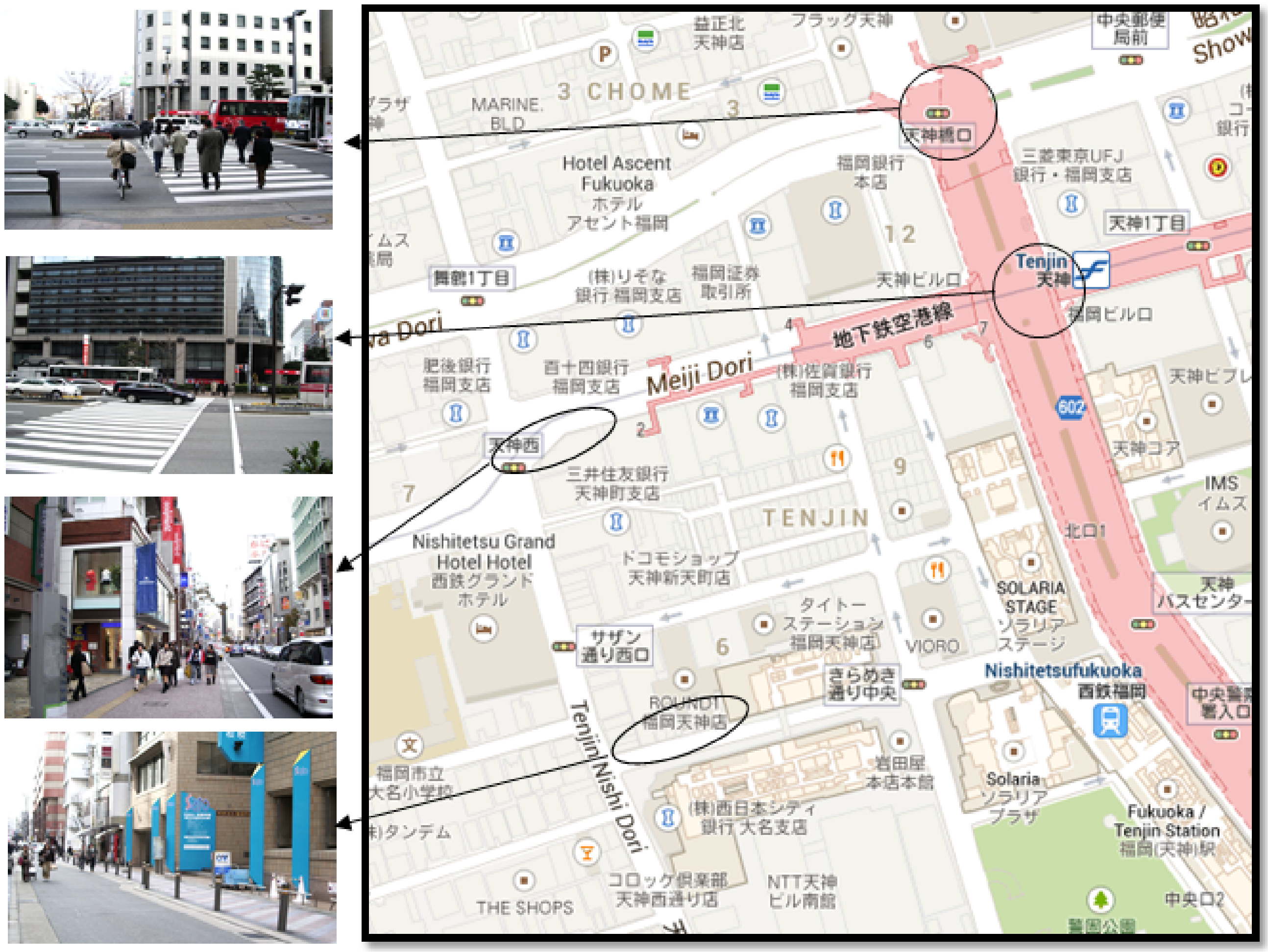


Figure 8-1e　Observation locations in Matsuyama

Note: Maps in Figure 8-1 are extracted from Google Maps.

8.2 Walking speed

Section 3.1.2 has previously described the key aspects of the observation data collection process. Two observers recorded the time taken by pedestrians to walk a predetermined marked length of the footpath. The observers selected pedestrians randomly and used a stop watch to measure the time. The start and end time to walk the selected length was recorded.

Two other properties were also recorded for pedestrian classification. One was the time of day. Four time of day periods were specified for this purpose. Each period was two hours long. These periods were called morning (8:00 am to 10:00am), lunch time (12:00 am to 14:00 pm), afternoon (14:00 am to 16:00 pm) and evening (17:00 pm to 19:00 pm. Evening, is typically when worker return home in most urban centers in Japan). Observers also categorized pedestrians to three types, namely “walking alone, male” “walking alone, female” and “walking in group”.

Cross-tabulation of sample sizes in each category is shown in Table 8-1.

Average speeds and variances were computed for the 60 cross-classifications (i.e. number of cells in Table 8-1). Table 8-2 shows results of the variance analysis performed to compare average speeds for the 20 city pairs for the 12 time of day and type of pedestrian cross-classifications. There is a statistically significant difference between certain pairs of cities in all twelve cross-classifications. In this tabulation, the first city mentioned in a pairing has a mean walking speed larger than that of the second city. The level of significance (null hypothesis being the mean values compared are the same) are the percentage values shown in Table 8-2. In general, significant differences exist between large cities (such as Tokyo and Osaka) and others. Recall that we classified cities according to population size into three categories in section 7.2.2 in a previous analysis. Tokyo and Osaka have well above 1.5 million in population and thus qualify them to the large category.

Table 8-1 Sample size of walking speed observation survey

		Walking alone, male	Walking alone, female	Walking together
Tokyo	morning	53	32	15
	lunch time	26	12	59
	afternoon	94	47	59
	evening	40	34	22
	Total	213	125	155
Osaka	morning	22	19	9
	lunch time	18	7	5
	afternoon	29	18	19
	evening	31	17	2
	Total	100	61	35
Kyoto	morning	29	17	4
	lunch time	36	40	22
	afternoon	67	65	57
	evening	36	12	2
	Total	168	134	85
Fukuoka	morning	85	53	12
	lunch time	38	37	15
	afternoon	30	33	87
	evening	59	51	40
	Total	212	174	154
Matsuyama	morning	24	23	3
	lunch time	26	20	4
	afternoon	18	21	11
	evening	24	21	5
	Total	92	85	23

In Table 8-2, the city pair Osaka and Matsuyama showed significant speed differences in a large percentage of cross-classifications. In order to save space, speed profiles for only these two cities are shown in Figure 8-2. The walking speeds are given in m/sec. The lowest average speed value within the two graphs is 0.97 m/sec (= 58.2 m/min = 3.5 km/hr) recorded during morning and evening time periods, by pedestrians walking together in Matsuyama. On the other extreme, the highest average speed is about 70% faster at 1.68 m/sec (= 100.8 m/min = 6.0 km/hr) in Osaka recorded by males walking alone in the morning. It is acknowledged that this analysis has not included children and disabled pedestrians who may have average walking speeds much less than observed here.

The average walking speed at any time period in Osaka, regardless of gender, was the highest average speed for cross classifications among all five cities considered in this survey.

Table 8-2 Significance test for differences of walking speed

	Walking alone, male	Walking alone, female	Walking together
morning	Osaka > Matsuyama Osaka > Tokyo Osaka > Fukuoka Tokyo > Matsuyama Tokyo > Fukuoka Kyoto > Matsuyama Kyoto > Fukuoka	Osaka > Matsuyama Osaka > Tokyo* Osaka > Fukuoka Tokyo > Fukuoka* Kyoto > Fukuoka	
lunch time	Osaka > Matsuyama Osaka > Tokyo Osaka > Fukuoka Osaka-Kyoto	Kyoto > Fukuoka	Osaka > Matsuyama* Osaka > Fukuoka*
afternoon	Osaka > Matsuyama Osaka > Kyoto Fukuoka > Matsuyama*	Osaka > Matsuyama* Osaka > Kyoto* Tokyo > Matsuyama Tokyo > Kyoto	Osaka > Matsuyama* Osaka > Kyoto Tokyo > Matsuyama* Tokyo > Fukuoka* Tokyo > Kyoto, Fukuoka> Kyoto
evening	Osaka > Matsuyama Osaka > Tokyo Osaka > Fukuoka Osaka > Kyoto* Tokyo > Fukuoka* Kyoto > Fukuoka	Osaka > Matsuyama Osaka > Tokyo Osaka > Fukuoka	Osaka > Matsuyama* Osaka > Fukuoka*

Note: *indicates difference is significant at 5%. All others have a difference significant at 1%.

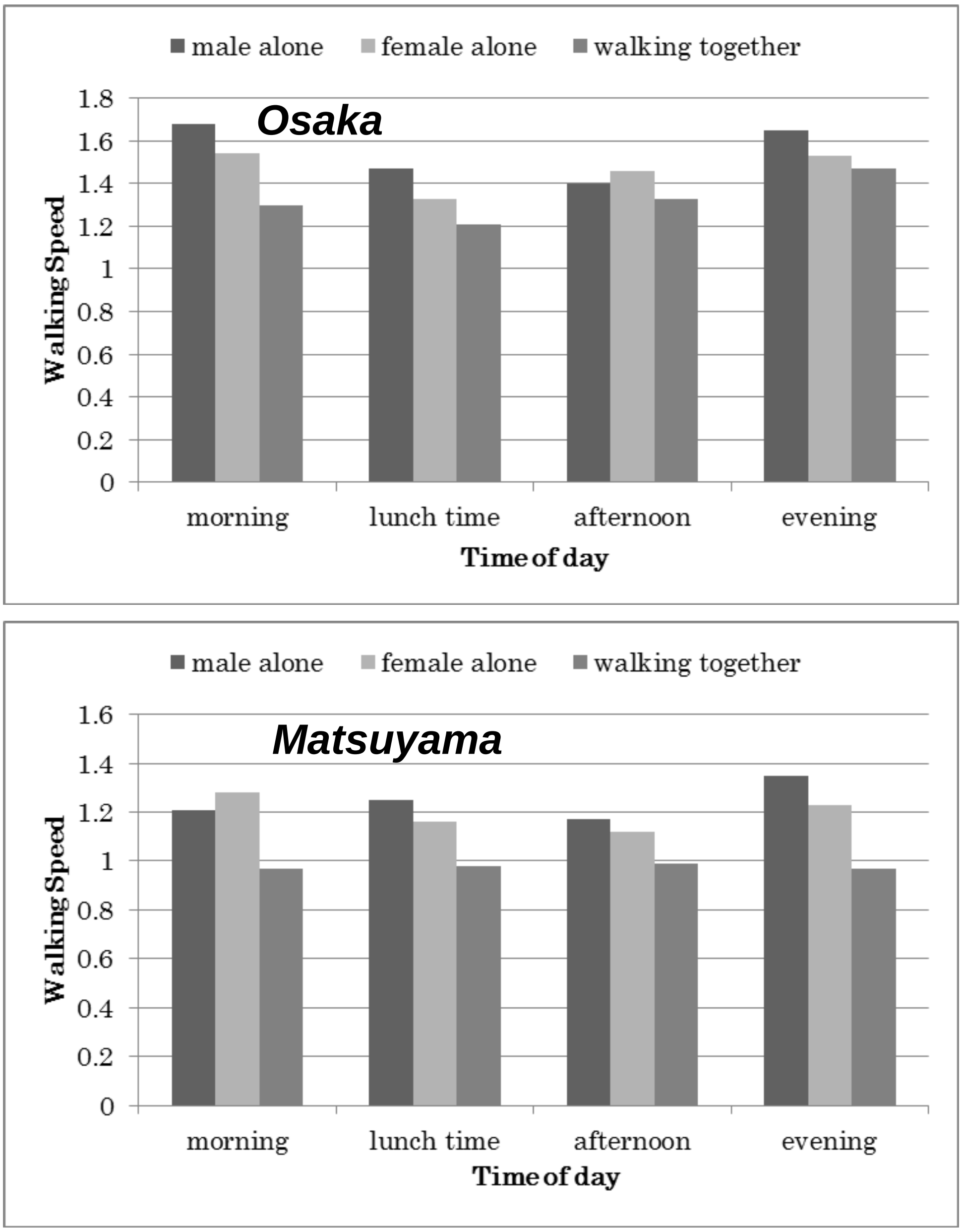


Figure 8-2 Walking speeds at different time periods of the day in Osaka and Matsuyama

It is worthwhile to recall that Table 7-3 showed there is no significant difference between city pairs about walking speed from the point of view of respondents. Yet observational data in Table 8-2 shows that there are numerous occasions where the difference of walking speed of residents from different cities is significant. It is likely that respondents were comparing their speed with fellow residents they meet during their daily life. Also, it is difficult for respondents to confidently compare their walking speed with those of other cities. Supplementary data obtained from observational survey allowed us to clarify the true nature of these speed differences.

8.3 Pedestrian signal compliance

As mentioned in Section 3.1.2, pedestrian behavior at signalized zebra crossings was observed for 50 cycles in the five cities. Analysis of this signal compliance data showed that average compliance rates are between 92.4% for Osaka and 99.5% for Fukuoka (Table 8-3). Pedestrians of large cities (Tokyo and Osaka) have displayed relatively poor traffic signal compliance. This is consistent with reflections of respondents from these cities, documented earlier in table 7-3.

Table 8-3 Signal compliance rates

	Tokyo	Kyoto	Osaka	Matsuyama	Fukuoka
Signal compliance rate	0.964	0.982	0.924	0.994	0.995

As average signal compliance rates shown in Table 8-3 are all within a small band and there is no large difference of this value among cities. Nevertheless, the statistical method has been applied to compare these mean values. First, we examined the regularity of signal compliance raw data. As observed data did not follow a normal distribution, the nonparametric variance analysis mentioned earlier in section 4 was applied for comparison of these data as well.

The Kruskal-Wallis test reveals that average signal compliance rates among the five cities have statistically significant differences. The Bonferroni's method mentioned earlier is then applied to find city pairs for which the differences are valid. There is a difference of the mean compliance rates in three city pairs, namely, between Osaka and Kyoto, between Osaka and Fukuoka as well as Osaka and Matsuyama, at 1% level of significance. Two other pairs of cities showed a difference at 5% significance. They are the city pairs of Osaka-Tokyo and Tokyo-Fukuoka.

8.4 Conclusions

The average walking speeds obtained ranged from 58.2 m/min to 99.6 m/min according to an observation survey conducted in 5 cities in Japan. Measured walking speeds were analyzed using a cross classification of gender with group size and time periods of day. Pedestrians in relatively large cities in this sample were found to be walking relatively faster than pedestrians in other cities. At the same time, pedestrians in larger cities were more likely to cross streets in violation of pedestrian signals. The signal compliance rates averaged between 92.4% and 99.5% in the cities surveyed.

Chapter 9. Accessibility to Public Transport and User Expectations

9.1 Chapter objectives - relationship between present level of pedestrian facilities and user satisfaction

Ease of walking to public transport facilities in an urban area contributes to the overall level of service provided by mass transit systems. This chapter reports study focused on user perceptions about the access system to public transport systems. Specifically, access to bus stops and railway stations are considered with a focus on trips originating from home. Accessibility to public transport in East Asian cities where this research work has been carried out is mainly in the form of walking trips, particularly in the context of journey to work. As such, the measure of accessibility considered here is the walking time from home to the nearest bus stop and the nearest railway station. It was hypothesized that we may be able to use the level of service of this element to demonstrate that there is a link between the improvement of a service and the level of minimum standards expected by the community.
From the point of view of conceptual model presented in Figure 2-1, this chapter investigates possible relationships between regional characteristics referred to as the level of service of urban infrastructure (denoted as **B** in the figure) and pedestrian characteristics referred to perceptions about existing pedestrian facilities (denoted as **iii** in the figure). The urban infrastructure considered in this analysis is limited pedestrian facilities from home to the nearest bus stop and railway station.

This chapter compares walking time acceptable to individuals against the perceived walking time to bus stops and railway stations using surveys carried out in Japan, Taiwan and South Korea. Outcomes of this analysis revealed the level of tolerance different resident groups have toward walking distance issues. The analysis presented is also able to show that there is an influence of the size of the urban area to community attitudes toward walking.

Investigations carried out here attempt to understand impacts of societal and urban system elements on the individual and his or her attitudes toward walking. Data collected about attitudes toward walking have shown certain randomness at first until data are viewed from the position of available level of service. This analysis has adopted walking time for measurement of level of service of accessibility and provides a comparison of walking time acceptable to individuals against the perceived walking time to bus stops and railway stations.

9.2 Data used in this chapter

Table 3-4 have earlier provided the population size and respondent sample size for cities surveyed. During the analysis it became clear that arranging graphs according to the size of the city is helpful in revealing underlying patterns, and the Figure 9-1 is presented in the population size sequence to be consistent with the pattern readers will later encounter during analysis and discussion of results.

Preliminary sorting of responses showed that the gender breakdown of responses could be considered acceptable as already shown in association with Figure 3-2. However, the response composition according to age groups has raised concerns because the percentage of respondents under 40 years of age was around 10% in all Japanese cities, though the percentages in Taiwanese cities and Korean cities were 74.8% and 35.8% respectively. Again, reasons for this disparity were discussed in previous chapters. The main reason could be differences in survey administration methods adopted in the three different countries.

Because of the focus on access to public transport systems, data related to respondents who stated that they use public transport facilities more than once a week and that they have a bus stop in the vicinity of his/her home are used for the analysis presented here. The analysis here made use of data from the first and second stage surveys performed in fifteen cities in Japan at as shown in Table 3-4. The total number of respondents in surveys conducted in Japan, Taiwan and South Korea were 3560, 1243, 912 respectively as previously shown in Table 3-4. We made use of five questions from the field survey for this analysis. The first question is to filter respondents who walk to public transport. This question allowed a yes or no answer. It was asked whether the respondent used public transport more than once a week for commuting or shopping trips. The total number of respondents who answered yes and thus selected for further analysis in Japan, Taiwan and South Korea were 1774, 247 and 720 respectively. In other words, the percentage of respondents who use public transport more than once a week has been 49.0%, 19.9% and 78.9% in the corresponding countries.

The second question asked was ‘What is the walking time from your home to the nearest bus stop?’ where six possible answers were offered to respondents. The allowed answers were: (1) Less than 2 min, (2) 2~5 min, (3) 5~10 min, (4) 10~15 min, (5) 15~20 min, (6) More than 20 min. The next question asked was ‘What is the acceptable walking time for you from home to the nearest bus stop?’ Again one of the six possible answers from the list mentioned earlier could be selected. To probe access time in relation to the railway system, two further questions similar to above were added to inquire about the perceived and acceptable access time in the context of walking to train stations.

9.3 Time required for walking to public transportation facilities

Section 9.3.1 provides results in relation to access to bus stops as the first step of the analysis. This analysis made use of data from all three countries. A separate analysis was then performed with the focus on access to train operations in the context of cities surveyed in Japan where train operations were available, excluding one city located in Okinawa prefecture that did not have an urban rail system. The results of that analysis have been observed to be consistent with the analysis of access to bus operations. Analysis of access to train operations will be explained briefly in section 9.3.2.

The first variable considered in this analysis is the access time to the nearest public transport service. This variable is a proxy for the walking distance that characterizes existing level of service of public transport (see A in the conceptual model explained with Figure 2-1) in terms of accessibility to such systems. It is the perceived access time that is available from the surveys. This is in keeping with focus on perceptions about existing pedestrian facilities (see iii in Figure 2-1). Anyhow, understanding of community perceptions regarding access to public transport facilities is of practical value to planners and transport system designers. Following analysis explores the respondent perception of present walking times from home to the nearest bus stop.

9.3.1 Time required to walk to the nearest bus stop

Figure 9-1 shows the access time distributions for the fifteen cities from Japan. For each city, the horizontal bar chart shows the percentage of responses for six ranges of perceived access time. The list of cities in this Figure is organized according to the population size after different attempts to organize the bar diagrams to yield a visually identifiable pattern. The largest city is in the top row and the smallest city is indicated in the bottom row. The population size sequence in the vertical axis appears to display a tendency of the bars to slope in one direction if one makes an allowance for some randomness of the shape.

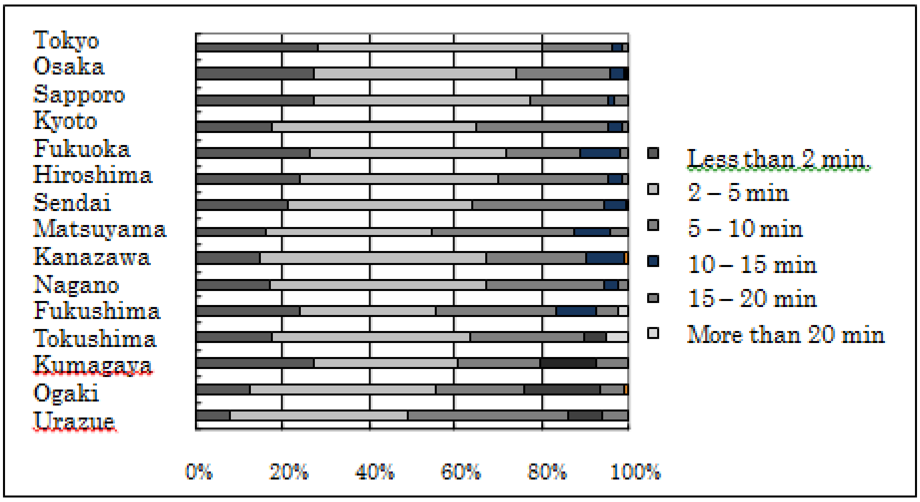


Figure 9-1 Perceived walking time to the nearest bus stop in Japan

The perceived walking time distributions for the four cities from Taiwan are shown in Figure 9-2, where the list of city in the vertical axis is sequenced according to the population size. It is encouraging to note that the sloping effect created by the bars shows some similarity to what is observed in the graph for Japan, shown in Figure 9-1

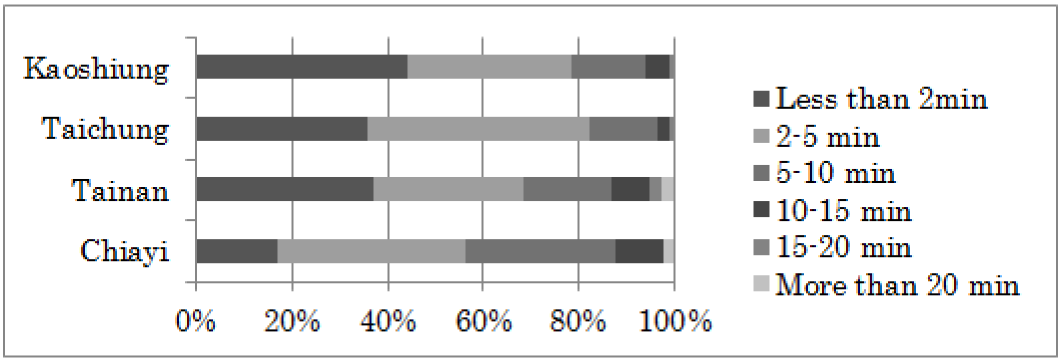


Figure 9-2 Perceived walking time to the nearest bus stop in Taiwan

Stated walking time distribution for the two cities in South Korea is shown in Figure 9-3. The bar diagram for Busan, the larger city, is shown as the first row in this diagram and the smaller city is below that. Although this diagram does not contradict the previous two diagrams, comparison of two cities alone is insufficient information to make observations about an underlying pattern that may or may not exist.

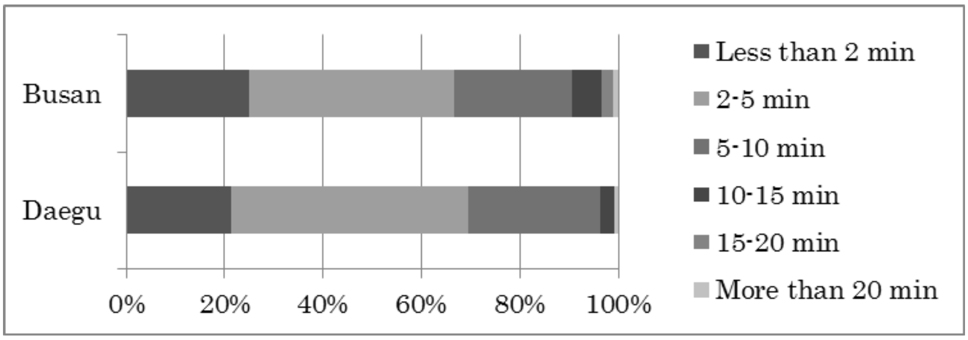


Figure 9-3 Perceived walking time to the nearest bus stop in South Korea

It can be argued that results already shown in Figures 9-1 to 9-3 for different cities spread over three different countries display a logical pattern because large cities provide an extensive bus network whereas relatively small cities are unable to afford a dense network. Thus, when we focus on those who perceived that they were two minutes or less away from the nearest bus stop in Japanese cities, this group contained about 28% in Tokyo. As we go downward in Figure 9-1, the city size becomes smaller, and so does the percentage of respondents in this particular category, even though the decline could be of a non-linear pattern. A similar distribution is observed when we add those who consider they are between 2 to 5 minutes away from a bus stop. In a large city, respondents that consider they are less than 5 minutes away from a bus stop constitute about 80%. In a small city this group is only 50%. Also, the percentage of residents who are more than 15 minutes distant from bus services grows from negligible in the largest city to about 7% in the smallest city.

To illustrate the above pattern more clearly, it has been decided to aggregate data obtained in Japan according to the size of the urban area to three groups. The first grouping is referred to as ‘large cities’ and each such city has more than 2 million population. The top two in the list of Japanese cities in Figure 9-1 belong to this category. Population values were provided earlier in Table 3-4. The next group is formed from cities with population between 0.3 to 2 million and this group could be named ‘medium size cities’ for the purpose of the current analysis. There are eight urban centers that belong to this category. The third group consists of ‘small cities’ for the purpose of the current analysis. These cities have a population less than 0.3 million. There are five such cities in Japan in this category.

Figure 9-4 shows results for walking time in Japan after above aggregation. This presentation has removed some of the randomness observed in Figure 9-1, and allows us to better accept there is a connection between the perceived walking time to bus stops and the city size. Responses from large size cities are in the topmost bar and those from small cities are in the lowermost bar. The perceived access time from home to the nearest bus stop at present is small in large cities. In large cities only a small percentage of respondents feel they have to walk more than 10 minutes to the nearest bus stop. This group alone is nearly 20% in small cities that are invariably served by a less dense bus network and perhaps a relatively large stop spacing as well.

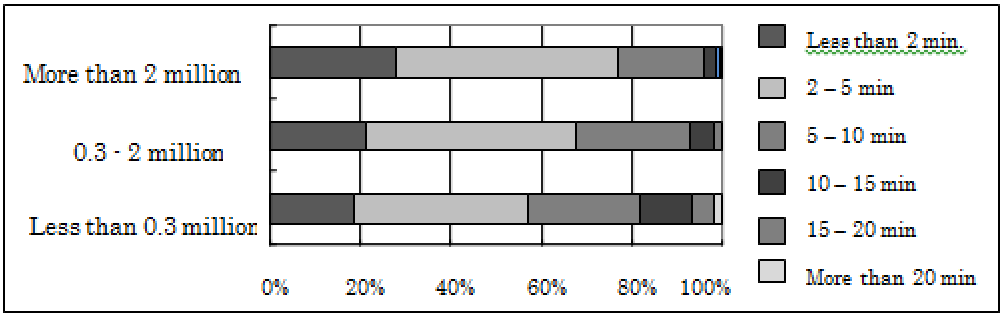


Figure 9-4 Distribution of perceived walking time to the nearest bus stop according to the size of city in Japan

The population limits adopted for categories specified for Japan means that the two cities considered in South Korea belong to the 'large cities' category. On the other hand, the population values of cities covered in Taiwan qualifies the cities to be in 'medium size cities' category. It is acknowledged that the smallest city considered in Taiwan had a population value just below the lower limit of the medium size classification. However, it could be considered sufficiently close to the medium size category for the present discussion.

Using the population size category structure, we can now compare the top bar of Figure 9.4 (Japan) against distributions shown in Figure 9.3 (South Korea). Respondents with less than 2 minutes walking time to the bus stop display comparable values in both countries, applicable for this population size category. Anyhow, it is noticed that there is some inconsistency when respondents with less than 5 minutes walking time are considered in the comparison. Similarly, distributions shown in Figure 9-2 (for Taiwan) can be compared with the second bar diagram in Figure 9-4 (Japan). It is difficult to explain why values for this less than 2 minutes walking time appear to be much different between the two countries for similar size cities. This maybe a result of differences in the level of public transport usage observed in the two countries. For example, in Japan, the public transport usage has a wide range from approximately 30% to 90% in different cities. On the other hand, public transport usage in Taiwan appears to be in a narrow range approximately from 20% to 40% in different cities. Although it is difficult to explain this magnitude of the perceived walking time observed in Taiwan in comparison to Japan, the pattern we mentioned earlier holds in Taiwan as well, according to visual observation of Figure 9-2.

9.3.2 Time required to walk to the nearest railway stations

Survey data from Japanese cities that have urban train systems are used for analysis in this section. The distribution of walking time from home to the nearest railway station is shown in Figures 9-5. Again, city names are arranged in the descending order of size (population), from top to bottom of the vertical axis. This diagram contains only 14 cities because the smallest city (Urazue) in the previous list does not have a railway service. Now, the pattern is not easily recognizable compared to situation seen earlier with access to bus stops. There is a saw-tooth pattern of access time blocks shielding our view of the underlying tendency similar to the one observed in Figure 10-1 that referred to access to bus stops. Anyhow, it is clear that the percentage of residents that consider they are within 5 minutes from a railway station is about 25% in the largest of cities in Japan, and this percentage shrinks to about 5% for relatively small cities. Similarly, the percentage of residents that perceive they are less than 15 minutes from a railway station is as high as 80% for a large city compared to a value between 20% and 40% for small cities.

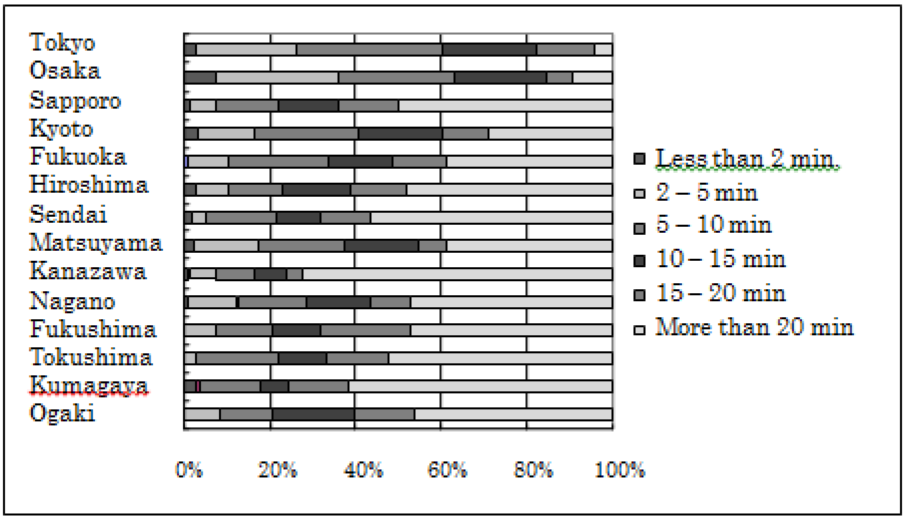


Figure 9-5 Perceived walking time to the nearest railway station (Urazue has no urban railway and therefore, it is not included in this diagram)

It could be speculated that the difficulty to see the trend clearly in Figure 9-5 is a result of lack of correspondence between the size of the city and the size of the railway operation. However, as we now know the trend we are looking for we can use an aggregation strategy to home into the underlying pattern. For this purpose, we make use of the classification of cities into three categories according to the population size, as done previously in section 9.3.1

Figure 9-6 shows corresponding results for the aggregation of perceived walking time to the nearest railway station. Much of the randomness that obscured the underlying pattern is now removed. Here too, it can be observed that the perceived walking time at present to the nearest railway station is small in large cities. It is also worth noting that there appears to be only a little difference between the perception of this attribute among residents in small cities and medium size cities compared to the significant jump in percentage terms between the medium and large size cities. A manifestation of this phenomenon will be revisited in a later section.

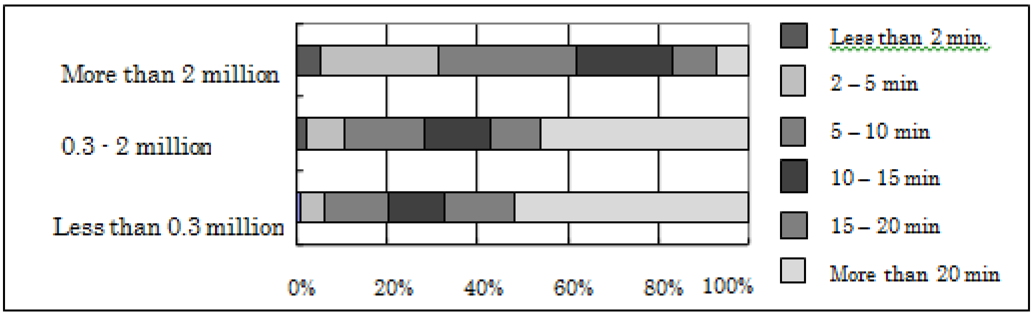


Figure 9-6 Distribution of perceived walking time to the nearest railway station according to the size of the city

9.4 Acceptable amount of time for walking

Next step of this analysis makes use of information about what respondents considered as the acceptable walking duration to the nearest public transport gateway. Another variable available from the survey provided relevant information about what respondents considered as the acceptable walking time to the nearest public transport facility. It may be obvious even at this stage that it will be of practical use for planners to compare this information with the current access time profiles reported in the previous section. Such a comparison will be presented in a following section. For now, this section analyses what respondents consider acceptable as walking time to the nearest bus stop and railway station. The question posed to the respondents asked for their opinion about acceptable walking time when the walking environment was considered good. The qualification about the walking environment being good in their opinion was included during the questionnaire design to obtain a holistic view of what respondents consider acceptable.

9.4.1 Acceptable time for walking to the nearest bus stop

Figure 9-7 shows acceptable walking time to bus stops in the same graphical structure presented earlier with Figure 9-1. It is acknowledged that it may be difficult to observe a clear pattern from the chart shown in Figure 9-7. Part of the problem is because it is incorrect to add horizontal bars and interpret in the same way as done with Figure 9-1. For example, in Figure

9-1, it is possible to visually add two adjacent bars for 'less than 2 minutes' and '2-5 minutes' and treat the total percentage as 'less than 5 minutes' of current access time. In Figure 9-7, such an interpretation is not possible. The 'less than 2 minutes' label in Figure 9-7 refers to the acceptable limit under favorable walking conditions and it is not of a practical meaning to add the next group '2-5 minutes' that states an acceptable limit in the second range. It may be possible to devise a method based on statistical methods by taking mid-point of the stated ranges. However, such a method was deemed not necessary here.

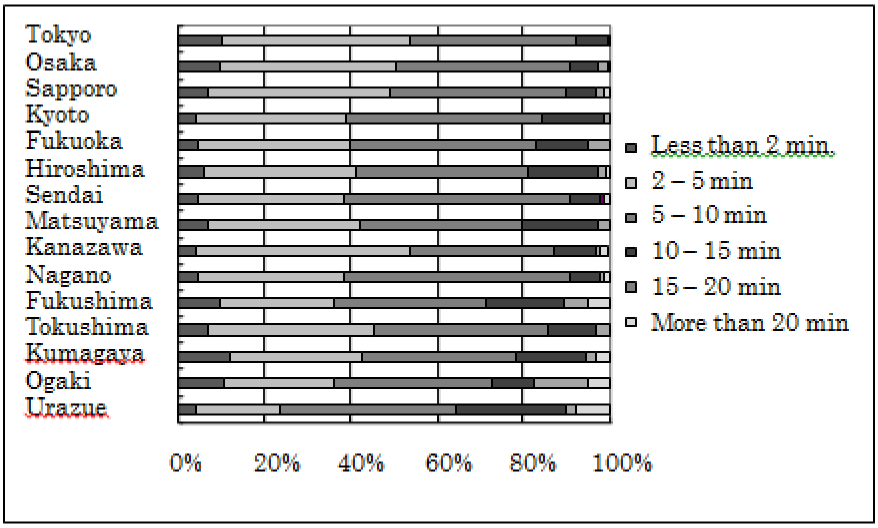


Figure 9-7 Acceptable walking distance to the nearest bus stop

A closer examination, while keeping the above interpretation trap in mind, shows that there is a pattern emerging. The 'less than 2 minutes' group has a range between 5% and 10% with a less than useful wave pattern along the different cities. Now consider the next group, who were willing to walk 2 to 5 minutes to the bus stop. Focus only on the bar length of that group, to observe that in large cities this group is about 40%. Keep focus only on the segment of the bar that represents '2-5 minutes' and scan downward along Figure 9-7 to appreciate that the corresponding percentage gradually reduces 20% at the small city at the bottom of the chart.

It may be evident that it is possible to add the bar segments from the higher end to make a meaningful interpretation. For example, adding three groups, '10-15 minutes', '15-20 minutes' and 'more than 20 minutes' provide the total percentage for the group that considers acceptable access distance is 'greater than 10 minutes'. This percentage grows large when we scan downward in Figure 9-7. For large cities this is a group less than 10%, and for small cities this could be up to 35% of the respondents.

As in the previous section, it has been observed that aggregation according to the size of city makes it easier to recognize the underlying pattern. Figure 9-8 shows the distribution of acceptable amount of walking time for respondents according to the size of city in Japan. The group of respondents who consider 2 minutes or less as access distance is about 10% of the sample, irrespective of the city size. However, the observation made previously about the group that is willing to walk greater than 10 minutes being relatively large in small cities is much clearer in Figure 9-8. A similar observation about increase in willingness to walk in small cities can be made about the group that is willing to walk more than 5 minutes. Therefore, in general, residents of small cities are willing to walk more than those in large cities.

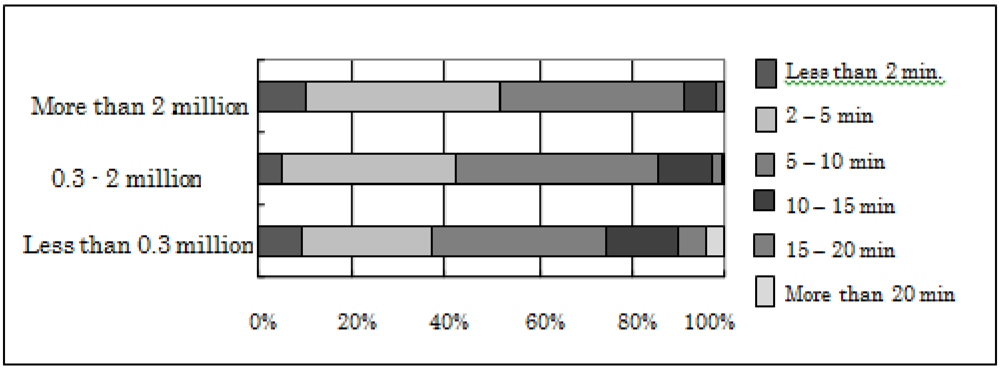


Figure 9-8 Acceptable amount of walking time to the nearest bus stop according to the size of city in Japan

Comparable findings for selected cities in Taiwan are shown in Figure 9-9. As before, the largest city is in the first row and smallest city is in the last row. The pattern we observed in Figure 9-8 for Japan appears to hold true in Figure 9-9 as well. In other words, in Taiwan also, residents in small cities are willing to walk more than those in large cities.

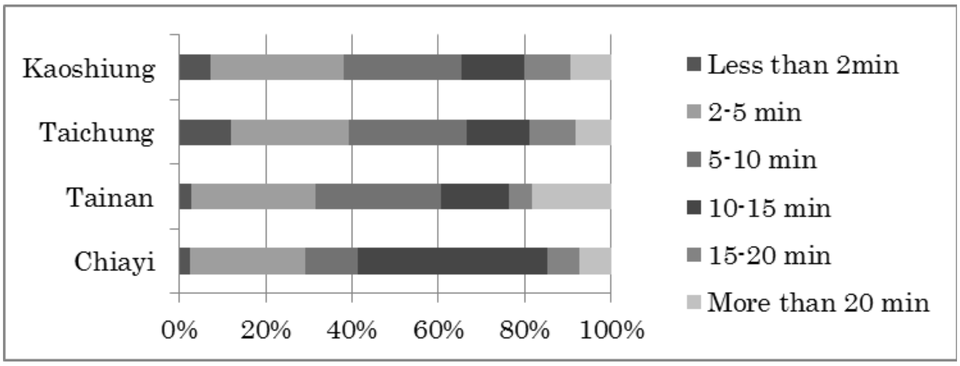


Figure 9-9 Acceptable amount of walking time to the nearest bus stop in Taiwan

However, the magnitude of percentage values shown in Figure 9-9 is much different from what is observed in Figure 9-8. These are medium size cities according to the classification adopted here for Japan. Therefore distributions shown in Figure 9-9 should be compared with the second row in Figure 9-8. For example, the percentage of residents that consider acceptable amount of walking time is greater than 10 is about 15% for a comparable size city in Japan (Figure 9-8, row 2). In Taiwan, the corresponding percentage of respondents has been much larger in the range of 35% to 60% (Figure 10-9).

Distribution of acceptable amount of walking time in the two cities selected in South Korea is shown in Figure 9-10. Here, the proportion of residents who consider the acceptable access time is greater than 10 minutes has been small. This magnitude is consistent with what has been already observed with results from Japan for large cities (Figure 9-8).

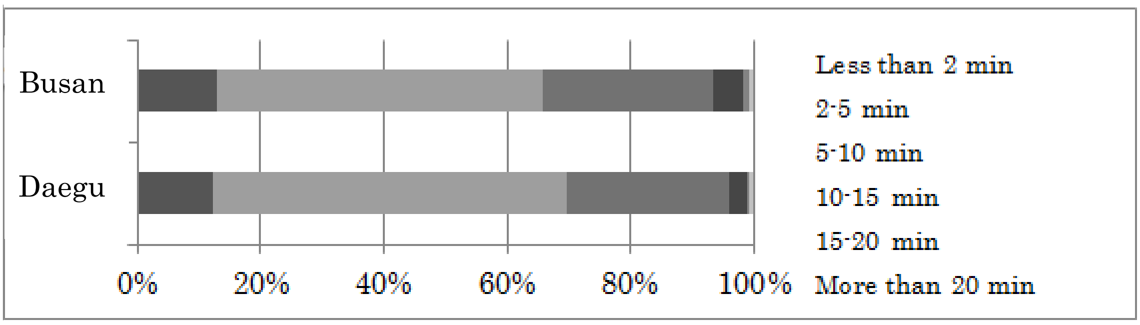


Figure 9-10 Acceptable amount of walking time to the nearest bus stop in South Korea

9.4.2 Acceptable time for walking to the nearest railway station

Now we return to focus on access to railway stations. Figure 9-11 shows acceptable walking times in the context of the nearest railway station. Again, it is the walking time in an acceptable walking environment the respondents have stated. A visual inspection following the method outlined in the previous section shows that in the context of the access to railway systems, the willingness to walk 15 or more minutes is about 10% in large cities and grows to about 40% in small cities. These values are not much different from the percentage values mentioned in the context of the access of bus stops in Japan.

Figure 9-12 shows results for acceptable amount of walking time aggregated according to the size of city in the context of access to the nearest railway station. The graph reinforces the observation previously made using data for access to bus stops. In other words, in small cities, residents are willing to walk a relatively long distance.

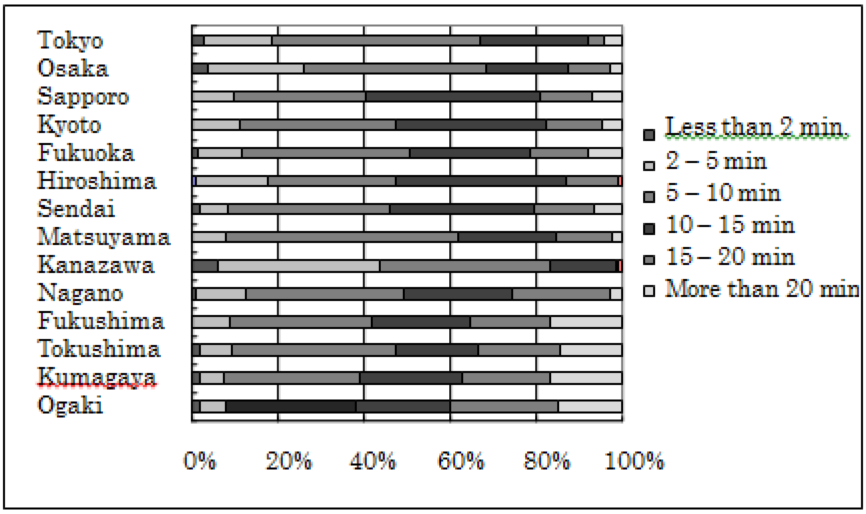


Figure 9-11 Acceptable walking distance to the nearest railway station

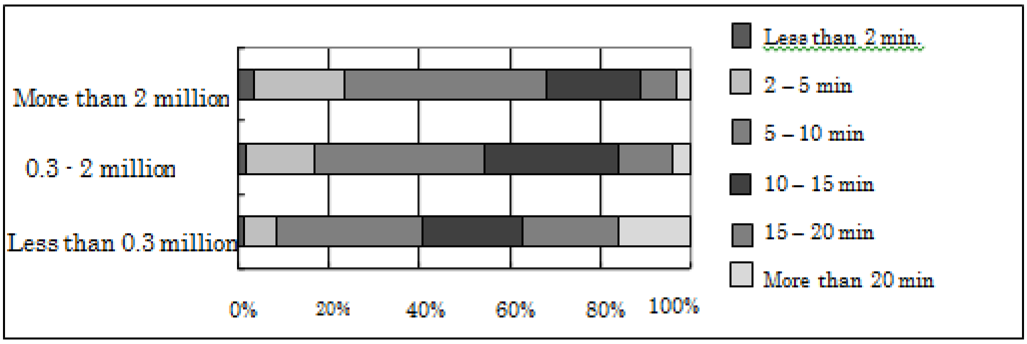


Figure 9-12 Acceptable walking time to the nearest railway station according to size of city

9.5 A relationship between perceived condition and the acceptable level of access

It is now possible to compare perceived current conditions seen in Figures 9-2 through 9-4 with acceptable levels reported in Figures 9-8 through 9-10. We will limit our discussion to access to bus services to avoid repetition of a discussion about similar patterns and outcomes when the analysis is performed with the focus on railway stations.

This part of the investigation is based on a cross-analysis method. Aggregate data according to the size of city is utilized for cross analysis of perceived present access time values against acceptable amount of access time. Figure 9-13 shows this cross analysis in the context of 'small cities' in Japan.

Further aggregation is performed in preparation of Figure 9-13 by combining data for responses where the perceived walking time has been considered larger than 10 minutes. In other words, responses that stated more than 20 minutes, between 15-20 minutes and between 10-15 minutes have been combined to form a single category of above 10 minutes of present walking time. This process has limited the vertical axis of this Figure to only four rows. This aggregation was performed because there were only a small proportion of data where the perceived walking time was greater than 15 minutes (equivalent to approximately 1.2 km of access distance) to the nearest bus stop, particularly for cities with medium and large populations.

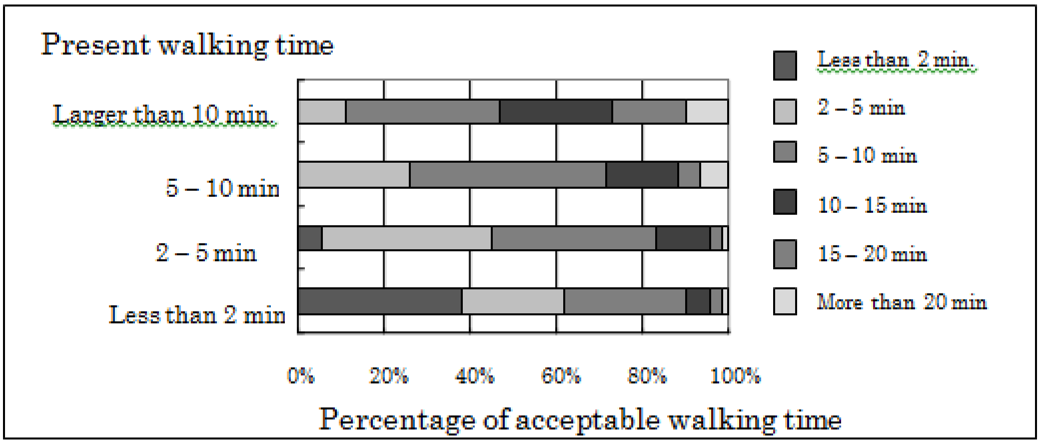


Figure 9-13 Cross-analysis for access to bus stops in small cities in Japan

The distribution of values in Figure 9-13 indicates a discernible visual pattern. The bar segments are stacked in a sloping pattern. Therefore, an attempt will be made to derive a quantifiable measure to explain this pattern in the next step of the analysis. Anyhow, it is worth making a visual comparison of the distribution in relation to 'small cities' in Figure 9-13 with corresponding results for 'medium size cities' in Japan as shown in Figure 9-14. It can be seen that bar segments of the distribution considered here has moved slightly to the left with the increase in the size of the city.

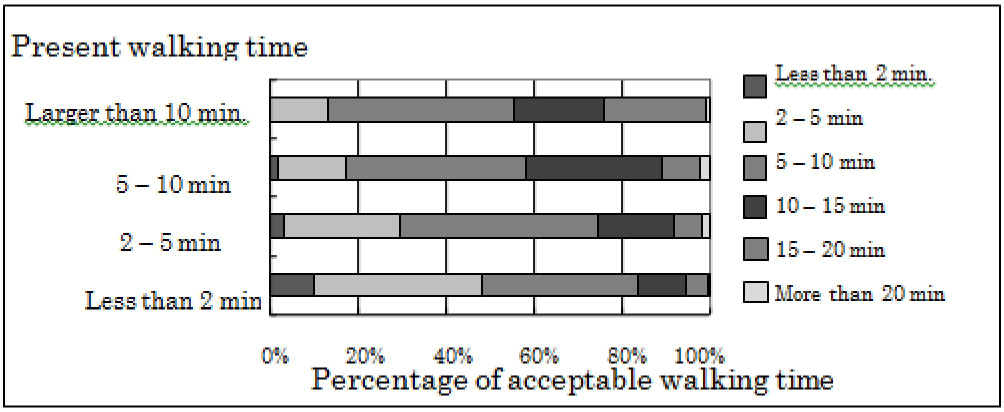


Figure 9-14 Cross-analyses for access to bus stops in medium size cities in Japan

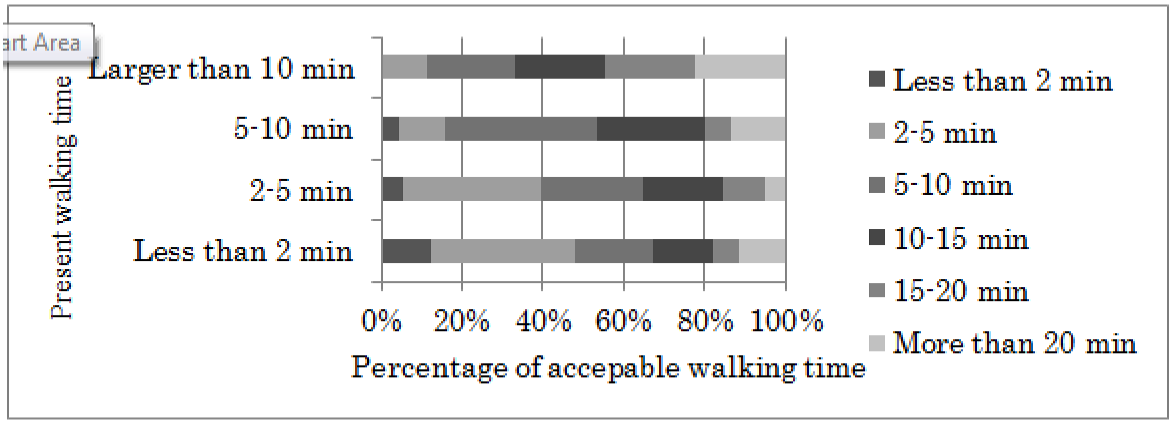


Figure 9-15 Cross-analysis for access to bus stops in Taiwanese cities

Recall that medium size cities in Japan contained the range of population values observed in cities surveyed in Taiwan. The corresponding distribution for cities in Taiwan is shown in Figure 9-15. Although there are some similarities in the patterns, it is clear that there are sizeable differences in magnitudes observed in comparison to Figures 9-14 and 9-15 which represent distributions for similar size cities from Japan and Taiwan. An analytical approach will be introduced in the next section to compare these patterns.

Figure 9-16 shows cross analysis results for ‘large cities’ in Japan. This distribution could be compared with Figures 9-13 and 9-14 that represent small and medium size cities. It can be seen that bar segments of the distribution shown in Figure 9-16 has also moved a little to the right with increase in the size of the city compared to the previous graphs. However, the directionality of the movement of bars is different when comparing ‘small cities’ to ‘medium size’ and then ‘medium size’ to ‘large cities’.

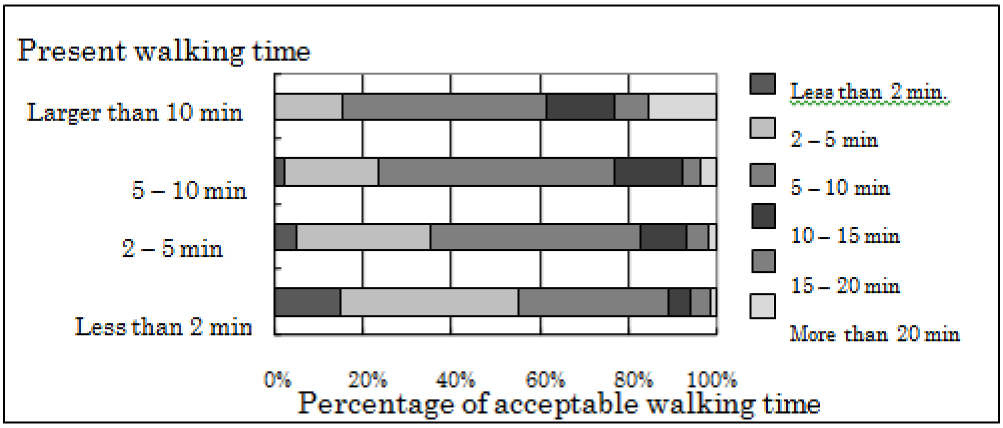


Figure 9-16　Cross-analysis for access to bus stops in large cities in Japan

Figure 9-17 representing results from South Korea are presented now to compare against the distribution of comparable size cities in Japan, as already shown in Figure 9-16.　Again, it is evident that there are differences between the two distributions that deserve further analysis.

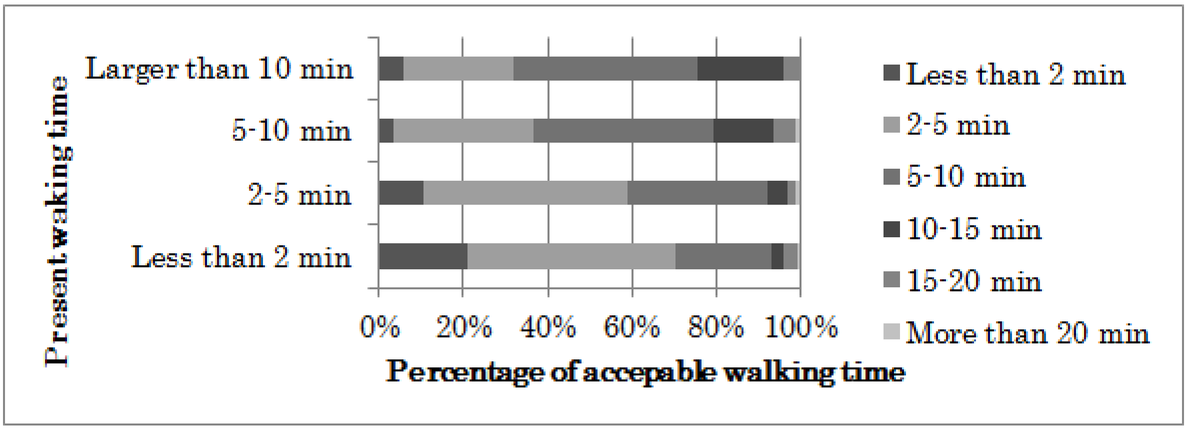


Figure 9-17　Cross-analysis for access to bus stops in Korean cities

Previous graphs (Figures 9-13 to 9-17) have shown that perceived walking time of the current urban environment and acceptable walking time to residents have an interesting relationship. It is evident that residents who live a long distance from the nearest bus stop usually accept a somewhat long walk. Conversely, individuals who do not have a long walk from home to the nearest bus stop expect a much higher level of accessibility.　In other words, the intensity of pedestrian expectations is related to the present condition in terms of quantity and level of service of accessibility to the urban transit system.　This analysis has allowed the research team to support the existence of this intuitive relationship using real world data.

9.6 Weighted average of acceptable access time

Further analysis using a quantitative technique to compare the patterns presented so far has also shown interesting results. A term referred to as the weighted average of acceptable access time is introduced now for the purpose of quantifying the distribution of acceptable walking time. This weighted average value of acceptable access time has been computed for the full horizontal bar of graphs shown in the previous section. The weighted average value is computed using multiplication of the percentage value of respondents in each category of acceptable walking time and the mid value of the particular time range.

Figure 9-18 shows computed weighted average values using the survey data covering 21 cities. Essentially there are five graphs in the figure. There are three graphs according to the size categories for cities in Japan as mentioned earlier. Also there is a graph summarizing the pool of data from the four selected cities in Taiwan and another graph based on aggregation of the two cities considered in South Korea. Horizontal axis in Figure 9-18 indicates the perceived access time respondents currently experience and the vertical axis shows the amount of walking time respondents consider acceptable to access a bus stop. Some observations made earlier are again revealed in this graph as well. For example, respondents who live far from bus stops have a tendency to quote relatively high acceptable access times. Those who live near bus stops tend to state a small amount of time as the acceptable access time. Figure 9-18 reveals three further characteristics not well identified until now.

The graphs cross the diagonal line in Figure9-18 at some point indicating that within a city there can be some residents satisfied and some dissatisfied with the level of service. The diagonal line represents the state where the respondent perceive current walking time is equal to his or her acceptable walking time. In another sense, this diagonal represents a neutral line. Points to the right and below the diagonal line reflect respondents with perceived current access time greater than the individual's acceptable access time. Points to the left of the diagonal line indicate respondents who consider the average access time they experience is less than what is acceptable to them. Not surprisingly it is respondents who live relatively distant from bus stops that are not happy with current access times although they are willing to tolerate a relatively longer access time.

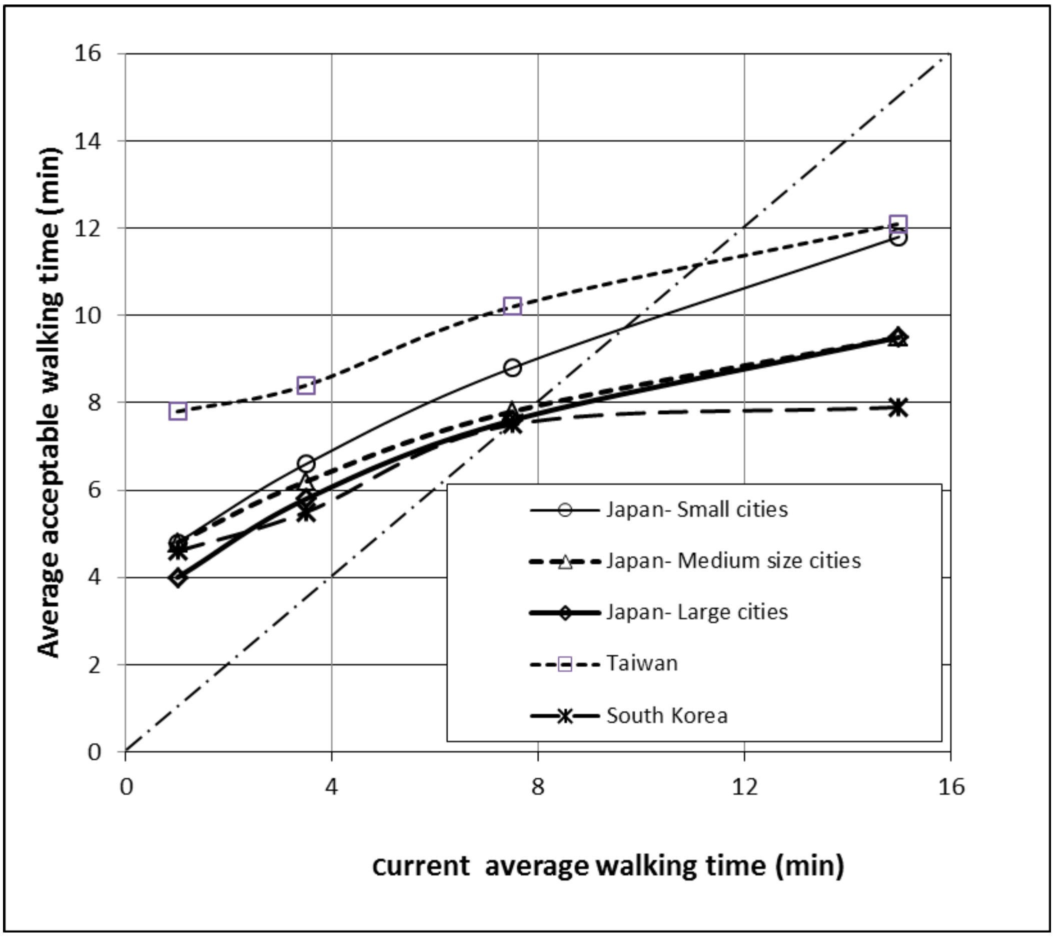


Figure 9-18 Acceptable walking time against the perceived walking time

It can be seen in Figure 9-18 that residents who live less than 5 minutes away from the bus stop are generally walking less than their stated acceptable walking time. We arrive at this conclusion because corresponding data points in all five graphs are to the left of the diagonal line. In other words, residents in this group are pleased with their access system to public transport. Within that group, those who currently live within 2 minutes of walking time to the bus stop are even more pleased with the accessibility than those who live between 2 and 5 minutes away from the bus stop. This characteristic is valid in all three countries considered in the analysis.

The next observation relates to what planners consider as an acceptable walking distance to public transport, especially to bus operations. In many countries urban transit planners would regard 5 minutes of walking time as a target access distance for design of bus operations. Figure 9-18 shows that this value has much merit particularly in large and medium size cities in Japan, and the two cities considered in South Korea. Graphs representing those cities have average values for the acceptable walking time to the bus stop varying between 4 and 10 minutes. It is even more interesting to note that this acceptable walking time is a moving target. As public transport accessibility standards improve (say the average access time is reduced from 16 to 8 minutes), the community increases its expectations (the average acceptable limit is reduced from approximately 10 to 8 minutes) according to graphs for medium and large cities in Japan. This phenomenon may indicate an influence from other aspects of economic development that may increase the value of time of individuals and lifestyle changes associated with increased level of wealth possible in a more urbanized environment. Anyhow, Figure 9-18 shows that any level of service improvement, where the average access time is pushed below 8 minutes (i.e. moved to the left of the middle of Figure 9-18) is rewarded with community acknowledgement that service standards are satisfactory. This observation is valid for all three countries investigated in this study, according to the lowest location where the graphs cross the diagonal line.

The final observation is about the significance of the size of the city. First, let us consider Japanese experience. There is a distinct cultural difference between small cities (those with less than 0.3 million population) and large cities (ones with more than 2 million population). The difference is somewhat more pronounced when respondents who live more than 10 minutes away from a bus stop are considered. The behavior of residents in medium size cities in Japan is even more interesting, as those who live close bus stops in a medium size city tend to follow the behavior of a small town counterpart, and on the other hand, those who live more than 10 minutes away from bus stops in a medium size city have the character of a similar resident in a large city such as Tokyo. This observation is not completely surprising as one would expect resident characteristics of a medium size city to consist of a spread of features of residents from small to large cities.

The graph showing values related to Taiwan in Figure 9-18 gets close to the graph for small cities in Japan at the upper end of the two graphs. This is unexpected, as cities considered in Taiwan are similar in size of population to medium size cites in Japan. Another anomaly is that at the low end, residents in Taiwan who currently experience a low access time has a much higher tolerance in their expectations in terms of the acceptable access time than similar residents in other countries. At this low end of current access time, the acceptable walking time in the graph for Taiwan is almost twice the value observed in graphs for the other two countries. Anyhow, the graph for Taiwan is almost parallel to the graph for medium size cities in Japan. This may indicate that the results are comparable between the two countries when slopes of the graphs are considered.

According to the size of population, cities considered in South Korea are comparable to large cities in Japan included in this study. The graph for South Korea closely follows the graph for large cities in Japan for about half of the length of the graph. However, beyond about 8 minutes of current access time for residents in South Korea, the graph flattens to a near horizontal line. This is interesting, as this flatness of the graph indicates a region where improvements to the perceived access time do not trigger any reaction (positive or negative) from residents toward their acceptable walking time. It is an unusual finding about patterns of expectations. However, this indicates an upper bound value of about 8 minutes is entrenched as the acceptable walking time among pedestrians in South Korea. It may be worth exploring whether this is an influence of other societal factors that may relate to lifestyle and local culture.

9.7 Conclusions

The objective of this chapter has been to provide a practical framework to transport system planners to deal with variations in attitudes of residents about acceptable amount of walking to reach public transport systems. Findings presented here are based on a questionnaire about walking to the nearest bus stops and railway stations. These surveys were carried out in fifteen cities in Japan, four cities in Taiwan, and two cities in South Korea. The cities selected had population values between 100,000 and 8.5 million. The average sample size in Japan was about 240, in Taiwan about 310, and in South Korea about 450 residents per city. Accessibility to bus services was analyzed for all cities. Accessibility to railway stations has been analyzed in those cities where urban train operations were available.

There were five important findings. Firstly, it has been possible to identify the relationship between the level of service in terms of current accessibility to public transport and acceptable walking time from the view point of the community. It has been revealed that people who live a long distance away from the nearest bus stop usually accept a somewhat long walk. Conversely, residents who do not have a long walk to the nearest bus stop expect a much higher level of convenience in terms of acceptable walking time. This relationship is particularly evident in relation to the access walking time to the nearest bus stop.

Secondly, it has been shown that the size of city explains part of the perceived quality of accessibility to public transport facilities. In general, relatively larger cities have a superior level of service in terms of access to public transport systems. This observation is logical as large cities can provide a high density of routes and stops that reduce the access distance compared to public transport operations in small cities.

Thirdly, there are country specific differences of attitudes about accessibility to public transport systems. Although cities considered in Taiwan are comparable in population size to medium size cities in Japan, graphs for expectations about accessibility presented earlier are different for the two countries, even though there is some similarity in the shape of the graphs.

Therefore, attitudes about accessibility to public transport facilities in cities of similar sizes in different countries could be different and should be treated with care.

The next finding has shown that, in general, the acceptable walking distance obtained from attitudinal surveys is a moving target. It has been possible to show in a quantitative manner that residents modify their expectations in light of the level of service experienced. Practical implications of this observation have been discussed earlier in this chapter. Nevertheless, it has been possible to identify an instance of an exception to this rule in South Korea where the stated acceptable level of service remains unchanged irrespective of the current experience of access walking time.

The fifth finding relates to two regions identified in the analysis framework. In the graphical representation, one region shows situations where expectations of residents are lower than the supplied level of service and another region where the supply is superior to the expectations. Further review of these two regions has shown that, in general, residents feel their access system is better than their expectations when the average present walking time is below 8 minutes.

Chapter 10. Lessons for Planning of Pedestrian Routes

10.1 Choice between planning shortest and pleasant pedestrian paths

Surveys and analysis discussed in previous chapters have shown that there is a significant variation of pedestrian opinions depending on the country, city, stage of life and existing urban system characteristics. It was observed earlier that low age groups prefer paths with short walking distances whereas senior age groups prefer a pleasant urban environment for walking paths. This type of phenomenon is not rare in planning literature and concepts related to dealing with these situations have been the subject of discussions. In general, planners are confronted with a trade-off situation between selecting “a short route” and “a pleasant path” for pedestrian infrastructure solutions.

It is worthwhile to note here that an analogues problem has been known as the Buchanan law in relation to the setting of environmental standards and accessibility standards to cater for motor vehicle traffic (Buchanan, 1963; Starkie, 1982). According to this conceptual framework, it has been argued that setting minimum environmental quality determines what we can achieve as the accessibility level under a given amount of overall funding for road projects. In the context of the present study, pedestrian facility planners have to face a similar situation when attempting to satisfy the two different needs, one of providing paths with good surroundings and one with providing routes that are relatively direct. For lack of a better terminology we select the term ‘pleasantness’ to refer to good environment and ‘directness’ to refer to shortness in relation to pedestrian facilities to explain this concept in Figure 10-1.

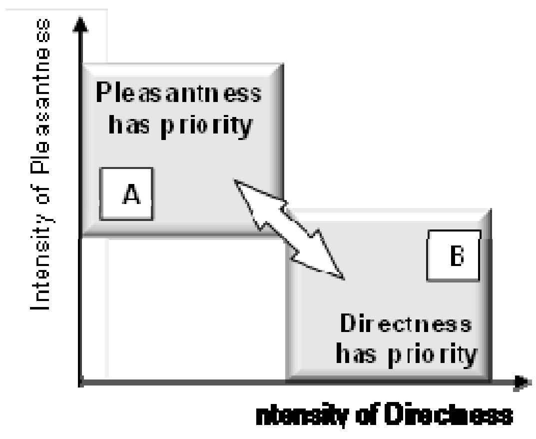


Figure 10-1 Conceptual diagram indicating duality of planning approaches required according to pedestrian needs

It is acknowledged that further research is required to better identify what is meant by respondents for terms such as 'shortest', direct' and 'pleasant' as this project has not explored this in sufficient detail. Anyhow, Figure 10-1 shows a schematic representation of the interplay between the two forms of user needs. The analysis has identified two zones. Facilities that provide the shortest path to the destination, termed 'direct paths' are preferred by one segment of the city population. Another segment of the population expects planners to spend on 'pleasant paths' to create a walking space that can enrich the urban environment. In any local setting, there could be examples for both types of such routes. Nevertheless, careful planning is required to make decisions about the optimum pedestrian facility design to well balance the two types of pedestrian needs.

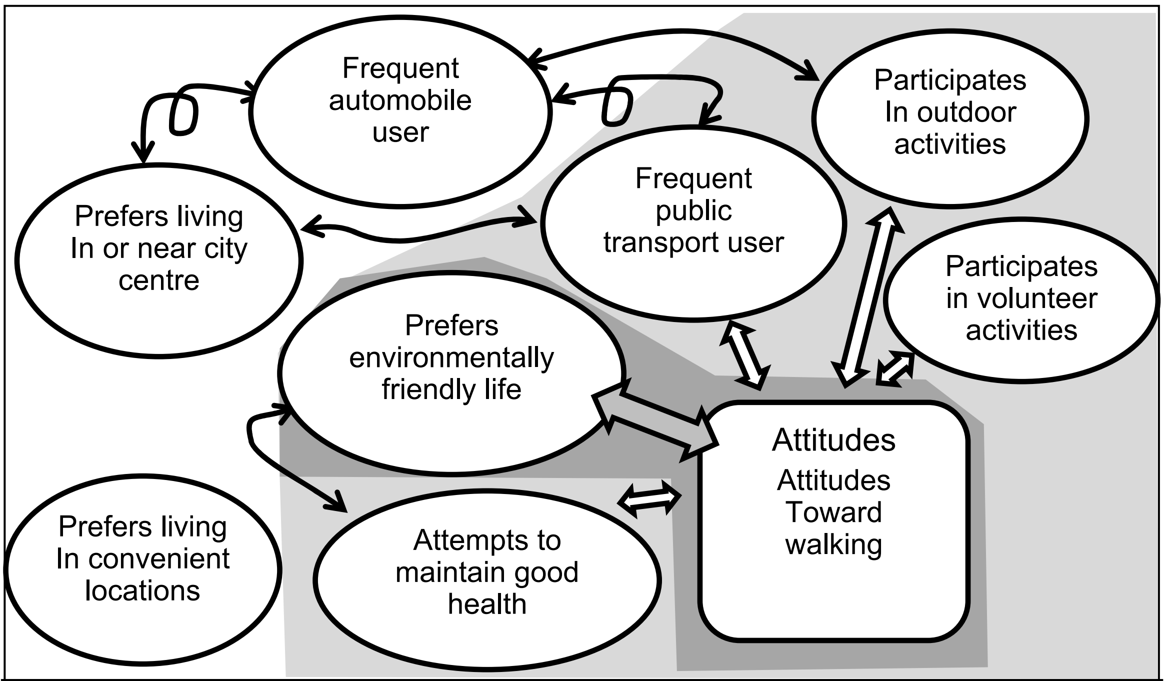
From engineering analysis point of view these situations are sometimes handled by providing a weighting according to the proportions of population with these different needs. Another approach is to develop a pedestrian path network that provides a range of solutions acceptable to different users. Anyhow, it is important to move away from the 'one size fits all' approach to cater for pedestrians. For example, pedestrian facilities near educational institutions could be designed with a bias toward satisfying perceived needs of users from early stages of life. Infrastructure associated with a commuter train station could cater for the majority of users from middle stages of life and their specific expectations.

For Japan which has a rapidly growing mature age population the zone A in Figure 10-1 could be the prevailing default state for planning work in the absence of demographic information about the user population. Zone B could be recommended as the default state for societies and localities with large proportions in other age groups for whom pleasantness is less important. Nevertheless, the key message of this research work is that user population demographics, in particular the stage of life, should finally determine the facility specifications for a particular location.

There is an opportunity to address other findings related to specific behavioral characteristics as well, within the above framework. For example, a previous section has shown that the 'traffic signal violator' behavior was more pronounced among low age groups. Therefore, pedestrian crossings where majority of users are young need to account for this behavior trait. In essence, traffic conflict locations have to be planned with care according to the distribution of stage of life of users.

10.2 Relevance of lifestyle for pedestrian facility planning

Lifestyle of the user population is another important variable as shown earlier in Chapter 7. Figure 10-2 is a schematic diagram prepared to identify lifestyle attributes that interact with pedestrian attitudes. The lifestyle attributes mentioned there were discussed earlier in section 7.3.2. Lifestyle attributes that place an importance on good health, participation in out-door activities and volunteer activities appear among those that can make an attitudinal change about walking. It is also possible that the attitudes toward walking have weighed in lifestyle choices people have made. As expected, a lifestyle that relies on use of public transport has the ability to affect attitudes toward walking as a transport mode.



See Section 7.3.1 for the lifestyle indicators mentioned within oval shapes. The most frequently observed relationship is shown within the shaded area with the strong arrow. The other relationships as shown within the lightly shaded area have been also well established in Chapter 7. Other single line arrows show interrelationships revealed among the surveyed lifestyle indicators, direct arrow links showing connections with a positive correlations and knotted arrows indicating negative correlations.

Figure 10-2 Influence of lifestyle indicators on pedestrian attitudes

Figure 10-2 is based on results from Chapter 7, and indicates that certain lifestyle indicators have a closer relationship than others. One indicator in particular, the environmentally friendly lifestyle was influential in surveys conducted in Japan and Australia. Four other lifestyle attributes were also has a significant relation to pedestrian attitudes, according to data from Japan. The diagram shows that three lifestyle attributes considered in the surveys have not shown a particular connection to pedestrian attitudes. The diagram also shows that certain lifestyle characteristics are supportive of each other, whereas the ones connected by dashed lines in the diagram are contradictory in general. For example, a person with high level of usage is unlikely to be also a one with a high level of public transport usage.

Figure 10-2 reflects that cities where majority of citizens use public transport provide a higher score for agreement with pedestrian opinion statements mentioned in section 2.2, (such as *(a) I like walking, (b) Walking is smart, (c) I am willing to walk for a short distance everyday* and *(d) I like to walking during leisure times),* than other cities. This observation implies that pedestrians and public transport users have beneficial experience when either of the systems (pedestrian or public transport) is improved. The current work has not yet attempted to quantify the benefit. What is relevant for now is that the surveys conducted during this project encourage planners to develop public transport and pedestrian-centered policy as the urban transport strategy.

Also, as expected, diagram indicates that citizens who participate in activities to maintain good health, join volunteer activities, and regard themselves as out-door type, have a general preference for walking. This suggests that transport planners can have a reasonable basis to collaborate with professionals of health and welfare, volunteer activities, and outdoor activities.

As indicated earlier, the most significant personal attribute from the point of view of likelihood to benefit from and support pedestrian infrastructure development is 'environmentally friendly' lifestyle. In that sense, encouragement of environment friendly lifestyle is consistent with the broader urban planning objectives of maximizing participation in transport options such as walking and public transport modes.

Chapter 11. Summary

Pedestrian infrastructure is an important part of the urban fabric. It is a responsibility of urban and transport planners to provide safe and user oriented facilities to cater for walking. The work presented in this book aims to show that there is much to be learned from potential users of pedestrian infrastructure, at the local level.

From a technical point of view, research work covered in this book has investigated the relevance of regional characteristics and pedestrian behavioral characteristics as set out in the conceptual framework shown in Figure 2.1. Regional characteristics considered here were separated to three categories as, (1) environmental attributes (2) properties of urban infrastructure and (3) sociological consideration of the regions. Surveys conducted and analyses performed during this project have revealed the presence of regional influences on pedestrian characteristics. Chapter 4 has provided a detailed comparison of different attitude statements posed to survey respondents in different countries and cities. The spread of scores provided by respondents from different regions enabled the research team to focus on connections between regional properties and particular characteristics related to pedestrian mobility.

The main objective of this book has been to document the research methodology followed in managing a project based on field surveys and analysis spread over 22 different cities spread over 4 countries. Important details of surveys methodology and questionnaire forms were presented in Chapter 2. List of cities surveyed, sample sizes and the sequence of surveys were also explained there. A selected number of socio-economic properties are presented in Figure 11-1 for the purpose of comparison to aid readers who may not be much familiar with these countries.

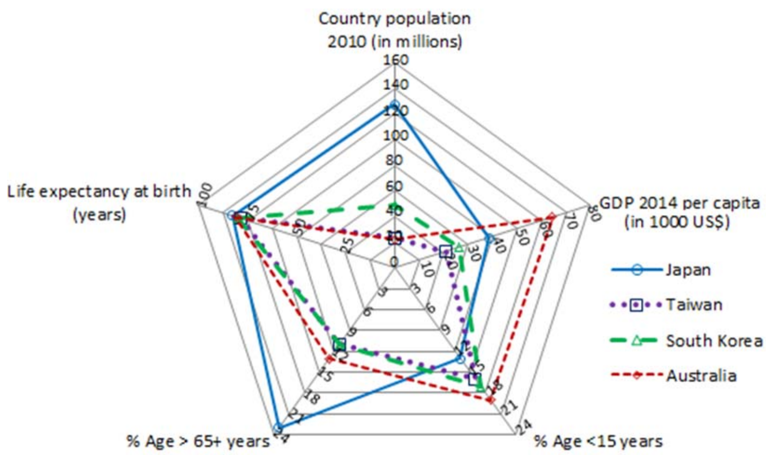


Figure 11-1 Spider-web form of presentation of selected socio-economic statistics of the four countries considered in previous chapters. (Data sources: PRB, 2010; IMF, 2014)

Core section of the questionnaire contained ten statements to uncover attitudes and reflections of respondents to various aspects of pedestrian personality. Chapters 3 and 4 have provided the list of these attitude statements and a preliminary analysis of these concepts using survey data.

The questionnaire also collected information about public transport usage frequency of respondents. Access path conditions and walking times to nearest bus stops and train stations of the urban public transport network were also obtained from survey data.

There were many of comparisons performed during this study based on statistical methods as explained in section 3.3.2 to ensure that conclusions derived from analysis have satisfied statistical tests. Also, spider web diagrams similar to Figure 11-1 already presented and scatter diagrams based on correspondence analysis have been presented often to provide visual verifications. The spread of quantifiable measures related to pedestrian characteristic has been observed during this analysis process.

Only one city was surveyed in Australia and there the average scores for each opinion statement have been relatively high compared to other countries. Further investigations are recommended to explore reasons for the pattern observed.

The project was segmented to analyze different types of connections that were considered important within the overall research framework as explained in Chapter 2. Table 2.1 provided a road map to broad areas of analyses conducted and chapters where the relevant descriptions have been eventually presented.

Chapter 5 integrated climatological classifications and associated concepts to discover the ability to cluster pedestrian characteristics according to the regional climate. Respondents and cities surveyed during the project could form four clusters of pedestrian types according to the analysis performed. There is sufficient evidence to consider regional climate as a factor that may be useful in prediction of pedestrian attitudes. This observation is interesting as seasonal variations of weather are known to influence pedestrian behavior within a given locality.

Chapter 6 addressed the relevance of "stage of life" to pedestrian characteristics, using age as the primary variable. Other descriptive variables attempted to use here with varying degrees of success include family type, marital status and length of time respondents have lived in their current urban area. It has been possible to establish the robustness of "age" to represent the stage of life to study pedestrian characteristics.

A particular finding of research interest from opinions expressed by respondents in Japan is that one age group prefers shortness of pedestrian paths and another group prefers walking paths to be located in a pleasant urban environment. Preference for the shortness of pedestrian paths in terms of distance becomes *less important* as individuals pass through different stages of life. On the other hand, preference for a pleasant environment surrounding for walking path becomes *more important* for individuals as they progress through the sequence of stages of life. It has been acknowledged that further research is required to adequately explain what respondents meant by terms such as shortest path and paths with pleasant environment. Findings about age based preferences were later considered from the view point of planning practice in Chapter 11 to draw lessons for the urban planning community. The proposed planning concept attempts to balance two types of pedestrian infrastructure in a location specific manner.

A finding of interest to regulators and road authorities is related to signal violations by pedestrians. Data reveals such violations to be a common occurrence. Also, analysis has shown that the propensity to ignore pedestrian traffic signals varies with the age group. This indicates the importance of knowing site specific demographics of pedestrians crossing a road in addition to demand forecasts needed for the traditional approach of engineering design for pedestrian crossing sites.

The connection between *lifestyle* and pedestrian attitudes were investigated in Chapter 7. This study has adopted eight indicators to measure lifestyle. These lifestyle indicators belong to three broad categories: public transport usage, lifestyle preferences, and non-transport activities. Initially, the study looked into co-relationships among these lifestyle measures. There are statistically valid connections between some lifestyle measures, for example between public transport usage and preference to live in or near the city center as shown in the schematic summary of findings presented with Figure 10-2, in Chapter 10. Certain lifestyle traits enhance the perception of individuals about pedestrian facilities and walking in general, possibly because those lifestyles may rely on walking as a transport mode. The schematic diagram has also identified lifestyle indicators that influence pedestrian characteristics. Lifestyles that place an importance on health consciousness, participation in out-door activities and volunteer activities appear among those that can make an attitudinal change about walking. Figure 11-2 is an attempt to summarize the interdependence of these concepts. As expected, a lifestyle that relies on use of public transport has positive impacts on pedestrian attitudes.

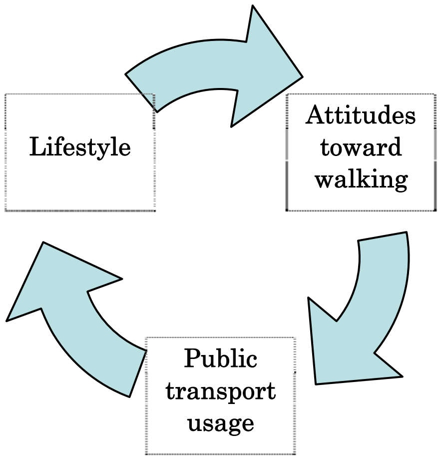


Figure 11-2 Connections among lifestyle, level of public transport usage and attitudes towards walking

Comparison of results between surveys in Japan and Australia has shown that both samples agree that a lifestyle stated as favoring environmentally friendly style has an impact on shaping pedestrian attitudes. It is encouraging to note that countries with different language and historical background can have a similar pattern of outcomes from adoptees of this lifestyle. Policy implications of this finding remain to be investigated.

Chapter 8 covered case studies based on observation surveys of five cities providing further information about speed characteristics, group behavior and gender impacts. The average walking speeds obtained ranged from 58.2 m/min (0.97m/sec) to 99.6 m/min (1.67m/sec) according to the observation survey conducted in 5 cities in Japan. Pedestrians in relatively large cities in this sample, especially in Osaka, were found to be walking relatively faster than pedestrians in other cities. Figure 11-3 shows comparison of walking speeds at different times during the day using data used for the detailed statistical analysis presented in Chapter 8. Data have also revealed that pedestrians in relatively large cities were more likely to cross streets in violation of pedestrian traffic signals.

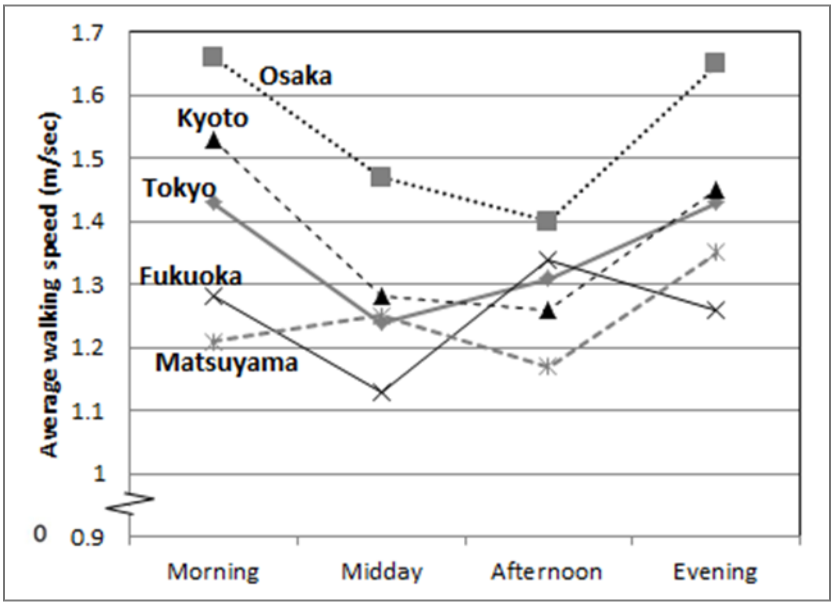


Figure 11-2 Comparison of average walking speeds in five cities in Japan

Chapter 9 has explored the survey data with the view of devising useful results for urban transport planners. It has been shown that the level of existing public transport in the urban area has an overarching influence on pedestrian characteristics. It has been possible to identify a relationship between the level of service in terms of current accessibility to public transport and acceptable walking distance from the community point of view. Also, it has been possible to show that residents who live a long distance away from the nearest bus stop usually accept a somewhat long walk. Conversely, residents who do not have a long walk to the nearest bus stop expect a much higher level of convenience in terms of acceptable walking distance. Reapplication of the aggregation technique explained in that chapter shows that a similar relationship exists in the context of access to railway stations as well. The analysis presented there has provided an insight to how pedestrians view access time depending on the size of the urban area and existing urban transport system properties.

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