Pedestrian Travel Pattern At Johor Bahru Commercial Centre

Noor Shazreen A.R.^{1,*}, Doris Asmani M.Y.¹, Li Sian Tey¹, Mohamed Khatif¹ and Haron H.Austo¹

¹Department of Civil Engineering, Universiti Teknologi MARA Kampus Pasir Gudang, Malaysia

²Faculty of Civil Engineering, Universiti Teknologi MARA Kampus Pulau Pinang, Malaysia

Abstract. Pedestrians are often exposed to complex and dangerous traffic situations. Therefore, planning for pedestrian facilities could reduce some of the problems that are faced by the pedestrians. Thus, this study describes the level of awareness, risky behavior and analyse pedestrian travel pattern in Johor Bahru (JB) commercial centre. Data for the study was collected from questionnaire distribution and video recording. Thirty sets of questionnaire were distributed with the purpose of determining the level of awareness among pedestrian while using the pedestrian facilities provided by the. Meanwhile, the video recording was used to determine the risky behaviour done by the pedestrians at commercial centres. The video was also used to analyse pedestrian travel pattern at commercial centres. The outcome of this study would be beneficial to JB cities and lead to a successful pedestrian travel pattern within a safety, practice, and knowledge of pedestrian facilities provided.

1 Introduction

Johor Bahru (JB) is the capital city of Johor state, stated in southern part of Malaysia. The city has a number of interesting commercial center buildings. However, traffic congestion in Johor Bahru is a daily feature and its impacts on the community are extensive. The commercial centre is typically the most frequent area where pedestrian is exposed to risk since it generates high pedestrian traffic. The purpose of this study is to demonstrate the integration of safety and other important societal goals which are crucial for pedestrians especially in urban areas. Therefore, it should be a high priority for the authorities to cater for the needs and vulnerability of pedestrians. In the study, several objectives have been laid down to address the issues. The objectives of the study are to determine the level of awareness of pedestrians using the facilities provided, identify the risky behaviour that predisposes pedestrians to accidents and analyse pedestrian travel pattern at commercial centres in Johor Bahru.

Road traffic injuries are a major public and development crisis but have been neglected in global public health problem. These situations are predicted to increase if road safety is not properly addressed. According to the statistics provided by World Health Organization (WHO) [1] and World Bank in World Report on Road Traffic Injury Prevention, in 2002, almost 1.2 million people were killed in road traffic accidents, which represents an average of 3242 persons dying each day around the world [2]. Millions of others sustain injuries, with some suffering permanent disabilities. From year 2000 to 2020, the total number of

road traffic deaths worldwide is forecasted to rise by some 65% in low-income countries whereas increased as much as 80% in middle-income countries [2]. Vulnerable road users such as pedestrians, cyclists and motorcyclists are the major contributors to the number of death cases. On the other hand, road traffic injuries were the 11th leading cause of death worldwide and accounted for 2.1% of all deaths globally. Furthermore, these road traffic deaths are accounted for 23% of all injury deaths worldwide as shown in Figure 1. In Malaysia, 6,811 deaths were reported in 2011 which resulted in a loss of RM 9.0 billion to the country's economy. On average, 19 people are killed every day in Malaysia, which makes road accidents a serious medical challenge to the country. This also indicates the need for a basic action that is effective [3].

Figure 1: Distribution of global injury mortality by cause (Peden et al., 2004)

* Corresponding author: noorshazreen@johor.uitm.edu.my

There are a few factors which influence the pedestrian crashes or fatalities. According to the report prepared by National Highway Traffic Safety Administration (NHTSA) of United States of America, over three-fourth of the pedestrians were killed at non-intersections and less than one-fourth were killed at intersections over the past decade [4]. Apart from that, the report also mentioned that the percentage of pedestrian deaths in crosswalks is less than deaths in roadways. Meanwhile, urban roads accounted for more than two-thirds of pedestrian crash deaths with nearly one-third of those on other principal arterial roads.

Other than that, a studied by Diaz shows that pedestrians fatality can be influenced by pedestrian's characteristics such as gender and age where adult and women is a low-risk group by committing to the rules [5]. According to Hamid pedestrians tend to take their risk by shorten their journey especially on the road that have central refuge or median because of longer waiting time and hastily to continue the other half of their journey [6]. While, Sisiopiku and Akin found that improper design and location of signalized intersections give an impact to the pedestrian behaviour when the travel distance for pedestrians become more distant to desired location [7].

The current study was conducted by pedestrian awareness survey and video recording of pedestrian travel pattern and risky behaviour. These methods were used to indicate the 'pedestrian compliance' parameter in order to measure the pedestrian behaviour in utilizing the facility provided. To provide more understanding, this paper provides Section 2, consisting of a description of study background and methodology of data collection. Section 3 presents the analysis of the result from the field surveys and Section 4 concludes the main findings

2 Methods

The study took place at the most developed state of Malaysia, which is Johor. Johor is located in the southern portion of Peninsular Malaysia. Johor Bahru is the capital city of Johor, having an area of approximately 220 square kilometres and a population of 497 067 as of 2010 [8]. The city is administered by the Johor Bahru City Council (Majlis Bandaraya Johor Bahru – MBBJ) and has obtained the city status since January 1st, 1994. The study area is focused at three main site locations at commercial centers area in Johor Bahru, including Galleria @ Kotaraya (Site 1), Johor Bahru City Square (Site 2) and Jalan Dato Onn opposite Johor Bahru City Council (Site 3).

Galleria @ Kotaraya is a five-storey shopping complex and previously known as Plaza Kotaraya. It is located in the heart of Johor Bahru with a gross area of approximately 546, 530 square feet and part of 11-acre Kotaraya Development Project, mooted by Johor Corporation [9]. The building is surrounded by office buildings, financial institutions, hotel, Persada Johor Convention Centre and tourist attraction. Figure 2 shows the layout plan for site 1.

Figure 2: Layout Plan for Galleria @ Kotaraya (Kotaraya)

City Square is strategically located in the central business district of Johor Bahru and it is one of the landmarks in the city. The seven storey mall is located at the busy road of Jalan Wong Ah Fook and connected to Sultan Iskandar Customs, Immigration and Quarantine Complex with pedestrian bridges. Apart from that, the building is comprised of thirty-six storey office block, which is divided into the lower, middle and upper zones and also three floors of basement car park. Figure 3 shows the layout plan for site 2.

Figure 3: Layout Plan for Johor Bahru City Square (City Square)

Johor Bahru City Council (Majlis Bandaraya Johor Bahru – MBBJ) is a local authority that administered Johor Bahru city centre and other areas within the perimeter. Among their responsibilities are to ensure that public health and sanitation, waste removal and management, town planning, environment protection and building control, social and economic development and general maintenance functions of urban infrastructure are well managed and monitored. The headquarters of MBBJ is located at Jalan Dato Onn, Johor Bahru. Figure 4 shows the layout plan for site 3.

Figure 4: Layout Plan for MBBB

This location has been selected based on high pedestrian activities due to the attractions of the areas. The pedestrian facilities available at the study areas are shown in Table 1.

Table 1: Pedestrian facilities available at the study areas

Facilities	Venue		
	Commercial Centre		
	Johor Bahru		
	Site 1	Site 2	Site 3
Pedestrian signal	√	√	√
Pedestrian crossing (zebra/ladder)	√	√	-
Median	-	√	-
Footwalk/footpath	√	√	√
Pedestrian bridge	-	-	-

There are two methods used in the study to collect the data, namely questionnaire distribution and video recording. The purpose of distributing a set of questionnaire for pedestrians present at the particular area and time are to determine their awareness while using the pedestrian facilities provided by authority and for them to answer it that best reflects their level of agreement or disagreement with the questions. Meanwhile, the video recording is used to determine the risky behaviour done by the pedestrians at commercial centres. Apart from that, the video recording is also used to analyse pedestrian travel pattern at commercial centres.

The level of awareness of pedestrians towards the facilities provided at the study areas were collected by distributing a set of questionnaire. There are three different variables included in the questionnaire, which are knowledge, practice and concern. Questions on knowledge represent the level of knowledge that the respondents have on the pedestrian facilities provided at the study areas while questions on practice represent whether the respondents apply or use the knowledge they have while using the facilities. The question on concern

is about whether the respondents are concerned about their safety while dealing with the facilities provided for them to use.

A pilot study was conducted before collecting the actual data by distributing 10 sets of questionnaire at the study areas. The questionnaire were then analysed to check its validity and reliability using Cronbach's Alpha (Table 2) in SPSS. Cronbach's Alpha measured the internal consistency on how closely related a set of items are as a group. Some of the questions unrelated for the study were discarded to ensure that the objectives of the study will be successfully achieved. The score from the analysis were interpreted as follows.

Table 2: Reliability coefficient of Cronbach's Alpha

Score	Reliability	Score	Reliability
> 0.9	Excellent	> 0.6	Questionable
> 0.8	Good	> 0.5	Poor
> 0.7	Acceptable	< 0.5	Unacceptable

Once the questionnaire had been revised and changed, the new sets of questionnaire were then distributed at the study areas, with 30 sets of questionnaire distributed at each location. The responses from the respondents were then analysed and recorded.

From the video recorded at the study areas, it was then analysed by using Statistical Package for Social Science (SPSS) version 23. The pedestrian risky behaviour at the study areas was observed through the video recording. The study area was surveyed to find the suitable place to install the video camera. The location must have a clear view of the pedestrian movement and behaviour as well as the facilities provided within the area of interest.

The first thing that has been observed is the status of compliance of the pedestrians while using the pedestrian facilities. In order to be categorized under compliant category, the pedestrians must use the facilities provided and obey the traffic rules in that particular study areas meanwhile the non-compliant category is vice versa from compliant category. Among the safe actions that can be categorized under compliant categories are using pedestrian crossing or pedestrian bridge to cross the road and obey the pedestrian traffic signal.

Other criteria that have been observed from the video are as follows:

- Pedestrian gender – male or female
- Carrying object while working such as handbag, backpack, sling bag and others
- Pedestrian age group – children, teenager, adult or senior citizen
- Facing an obstacle while walking such as cars, buses and others
- Pedestrian characteristics – individual, partner or group

Apart from that, pedestrian travel pattern has also been observed and sorted out based on the compliance behaviour of the pedestrians. The pattern made by pedestrians is either compliant or non-compliant were then marked on the schematic diagram of the facilities provided in the study areas.

3 Result

3.1 Determination of level of awareness

In determining pedestrian's awareness, 30 sets of questionnaire survey was distributed at each site to observe the response of pedestrian towards the pedestrian facilities provided and pedestrian rule adherence when crossing the road. As stated in Section 2, Chronbach's Alpha Coefficient was used to analyze the question. The result, as shown in Table 3 is above 0.5 which reflect that the question is acceptable to be used for the survey.

Table 3: The Chronbach's Alpha Coefficient for selected study areas

Study Areas	Alpha coefficient (α)
Site 1	0.856
Site 2	0.815
Site 3	0.828

The questionnaire was divided into three variable of interest; 'knowledge', 'practice' and 'safety' in order to justify the level of awareness. Each variable of interest was analyzed using scale factor analysis with scale 1 to 5 (strongly disagree to strongly agree). The average scale data for each variable was calculated using SPSS and represented as means of score value. Table 4 shows the level of awareness of each variable of interest.

Based on the mean score result, the variable of interest for 'knowledge' indicates the highest mean score followed by 'practice' and 'safety' for all the study areas. The level of 'knowledge' records the score of 4.042, 4.219 and 4.039 for location 1, 2 and 3 respectively. Meanwhile, 'practice' records 3.817, 4.056 and 3.839, and as for 'safety' it records 3.647, 3.536 and 3.644 for location 1, 2 and 3 respectively.

Results of the analysis illustrate that pedestrians disregard pedestrian safety by not using the facilities provided even though they know the purpose and function of the facilities. These values reflected that pedestrian do not practice the pedestrian law as much and do not really aware of their own safety even though they have a higher level of knowledge

Table 4: Means of score for each of the study area

Study Area	Variable Interest	Means of score
Site 1	Practice	3.817
	Knowledge	4.042
	Concern	3.647
Site 2	Practice	4.056
	Knowledge	4.219
	Concern	3.536
Site 3	Practice	3.839
	Knowledge	4.039
	Concern	3.644

3.2 Determination of pedestrian risky Behaviour

Figure 5: Graph of percentage of compliance according to the pedestrian criteria

Based on the description in section 2, pedestrian movement were classified into five potential variables behavior which were based on gender, carrying things, facing obstacles, categories of group walking and age. Figure 5 shows the result of compliance behavior from video recording observation.

Data from the three study sites was combined for the analysis. Based on the three study areas, 25.65% of females comply the safety behaviour compared to with males, which scored 25.28% of the gender criteria. This proves the statement of the previous studies that women tend to comply the rule and are more careful than men when crossing the roads [10]. For the carrying things compliance criteria, 27.23% of pedestrian are recorded to not carry things and it shows the highest percentage compared to only 22.47% of pedestrian who carry things. Meanwhile, the pedestrian who do not face any obstacle to cross the road tend to comply the criteria with the highest percentage of 37.12% rather than only 10.69% that comply the rule with obstacle. Pedestrians tend to expedite their journey in order to decrease the burden of carrying things and to avoid the obstacles. Walking individually indicate the highest percentage, with 27.41% of the walking categories instead of 25.82% who walk in a group. Lastly, the highest compliance age group criteria were senior citizen, which recorded 28.82% of the total group and the least compliance were children group (14.71%). The finding shows that senior citizen age group has the highest compliance rate, which is coincided with common understanding from previous

study which have found that the risk of fatality become higher along with the increasing on the age [4-5 , 11].

3.2 Determination of travel pattern analysis

There are four travel patterns observed based on the observation which are similar in all study area. From Figure 6, the compliance pattern was represented by Pattern 1, whereas pattern 2, 3 and 4 are the non-compliant pattern since the pedestrian cross the road outside of the designated area.

Figure 6: Travel pattern at pedestrian zebra crossing facilities at Site 1, 2 and 3

Figure 7 shows the travel pattern analysis where the highest compliance percentage was in Site 3 with 40.60%, followed by Site 2, 32.71% and Site 1, 17.88%. Unfortunately, overall location shows that more than half of the pedestrian disregard their safety by neglecting the rules and not using the facility provided. The result pattern was contributed by the location itself, where Site 1 and Site 2 were the central point of shopping areas, rather than Site 3 which is surrounded with administrative area. Other than that, the only location facilities provided at Site 3 were pedestrian signal and a foot walk/footpath at straight line crossing that help encourage pedestrians to comply with the rules. As for the junction area as at Site 1 and Site 2, it provides a lot of options to pedestrians to shorten their trip.

Figure 7: Percentage of compliance according to the survey venue

4. Conclusion

From the overall analysis, it can be concluded that the level of awareness at the three locations indicates that respondents tend to disobey the rules by not practicing the knowledge and neglecting the concern for their safety even though they have high level of knowledge about the benefit of implemented facilities and rules. From the observation, the groups that show the highest percentage of non-compliant behavior were the males, children, pedestrians walking in a group, pedestrian carrying things and facing an obstacle when crossing the road. These groups were exposed to the risk of accident and fatality. In addition, there are variations of pedestrian travel pattern. The results have proven that pedestrian crossing facilities need to be improved in the junction area as pedestrians have many options to shorten the trip even they have to risk their lives by violating the rules.

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References

1. World Health Organization (WHO), World Report on Road Traffic Injury Prevention, pqs.who.int/iris/bitstream/10665/42871/1/9241562609.pdf (2004)
2. M. Peden, R. Scurfield, D. Sleet, D. Mohan, A. A. Hyder, E. Jarawan, E. Mathers, World Report on Road Traffic Injury Prevention. Geneva. Retrieved August 30, 2016, from injury_prevention/road_safety_status/2013/en/ (2004)
3. Jabatan Keselamatan Jalan Raya (JKR), Pelan Keselamatan Jalan Raya 2014-2020. (Ministry of Transportation report) <http://www.mot.gov.my/SiteCollection/Docs/Darat/Pelan+KJRM+2014+2020.pdf> (2014)
4. National Highway Traffic Safety Administration (NHTSA), *Traffic Safety Fact 2012 Data*. U.S. Department of Transportation (2014)
5. Diaz, Theory of planned behavior and pedestrians' intentions to violate traffic regulations, Transportation Research Part F (2002)
6. Hamed, Analysis of pedestrian's behavior at pedestrian crossings, 63– 82, (2001)
7. Sisiopiku, Akin, Pedestrian behavior and perceptions towards various pedestrian facilities: an examination based on observation and survey data. Transportation Research Part F (2003)
8. Malaysian Digital Repository, Background of Johor Bahru City Council and History of Johor Bahru [http://myrepositori.pnm.gov.my/bitstream/123456789/752/3/Majlis%20Bandaraya%20Johor%](http://myrepositori.pnm.gov.my/bitstream/123456789/752/3/Majlis%20Bandaraya%20Johor%20Bahru.pdf)

- 20Bahru%20%5BSumber% 20Internet%5D.pdf
(2013)
9. Damansara Assets Sdn Bhd. The Latest Retail Signature In Johor Bahru City, <http://www.galleriakotaraya.com/usr/deal.aspx?pgid=19> (2016)
 10. Tom A & Granie M (2011). *Gender differences in pedestrian rule compliance and visual search at signalized and unsignalized crossroads. Accident Analysis and Prevention*. Elsevier
 11. Martin A. (2006). *Factor Influencing Pedestrians Safety: A Literature Review*. Retrieved September 2, 2016, from <http://content.tfl.gov.uk/factors-influencing-pedestrian-safety-literature-review.pdf>