Proceedings of the Eastern Asia Society for Transportation Studies, Vol.12,2019

Identification of Factors Towards Contributing Frequency of Walking to Access Urban Rail Transit Station

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Abstract: Traffic congestion has been worsening in a car-dependency city during morning and evening peak hours. Thus, urban rail transit is one of the alternatives that can be adequately considered in addressing the tremendous increase in travel demand due to its exclusive right of way. The purpose of this paper is to identify the factors which contribute to the frequency of walking to access urban rail transit station. Three respective Light Rail Transit (LRT) stations at Kelana Jaya and Ampang lines were selected in Greater Kuala Lumpur (GKL). A set of questionnaire consist of trip-maker and trip-making characteristics, as well as perception on walking to LRT stations, were distributed to the respondents who access the LRT stations by walking. Frequency distribution, correlation, Relative Importance Index (RII), and Binary Logistic Regression were used to analyze the findings.

Keywords: Light Rail Transit (LRT), trip-maker characteristics, trip-making characteristics, Relative Importance Index (RII), Binary Logistics Regression.

1 . INTRODUCTION

In a car-dependency mode of transport city like Kuala Lumpur, traffic congestion has been worsening particularly during morning and evening peak hours. Urban rail transit is one of the alternatives that can be adequately considered in addressing the tremendous increase in travel demand due to its exclusive right of way. Light Rail Transit (LRT) is one of the major urban rail transits which is being used to commute urban commuters in Greater Kuala Lumpur (GKL). The purpose of this paper is to identify the factors which contribute to the higher frequency of walking to LRT stations by selecting respondents at six LRT stations, three each along Kelana Jaya and Ampang line. They were asked on their characteristics, perception on the use of LRT as well as walkability. Logistics regression is used to see the effect of these factors on the frequency of walking to LRT. The structure of this paper consists of a few sections; methodology, trip-maker characteristics, perception on the use of LRT services and

walkability, level of satisfaction and agreement on pedestrian infrastructures designs, the frequency of walking and other variables, predicting the frequency of walking to LRT stations, discussion and conclusion.

2 . URBAN RAIL PASSENGER CHARACTERISITCS AND PEDESTRIAN INFRASTRUCTURES

The relevant of an urban rail station is to attract passenger ridership. Most experts agreed that high land use density surrounding urban rail station could able to increase passenger ridership. The authors stated that rail-based transit stations in the high-density urban area are usually a few, located at strategic locations supported by feeder bus services. The standard benchmark for land use density surrounding transit station idea ranging from 50,000 to 100,000 population at 40 to 200 persons per hectare (Gori et al., 2012).

Pedestrian infrastructures design do influence on passenger ridership. One of the transit services significant components is the provision of pedestrian infrastructures design (Colonna, Berloco, & Circella, 2012; Loo et al., 2010; Ozbil, 2009). Thus, pedestrian infrastructures are not just standby its own by complementing transit services. The most effective transit users are those who walk to transit services without any dependency on the private automobile. So that transit will able to achieve its purpose to reduce congestion on the road and increase people mobility. It also helps to connect residential, commercial, institutional, and stand-alone parking space to a transit station or vice versa (Cervero & Kockelman, 1997; Daamen & Hoogendoorn, 2003; Srinivasan, 2000). Therefore, pedestrian infrastructures are relevant to serve mobility as well as sustaining economic activities and social welfare.

Literature suggests that pedestrian linkages connecting land use and transit station have a catchment around 400 meters to 800 meters mainly to attract Pedestrian-based Transit Ridership (PBTR) at transit station (Gori et al., 2012). It is efficient so that land uses connect transit station within walking distance. The pedestrian infrastructures and facilities such as retail kiosk and benches, resting places as well as the shaded area are encouraged.

Studies taken in California found that improvement of pedestrian infrastructures design such as walkways, landscaping, and street lighting can encourage passenger ridership. It is crucial as in the context of Malaysia; people are fearful of walking to a transit station due to crime scene usually take place at low illumination of lights areas. (Shankar, Sittikariya, & Shyu, 2006) have agreed that pedestrian infrastructures design such as connected walkways either with roof or shades, crosswalk, traffic lights, pedestrian signage, benches, lighting, landscapes, and security camera are determinants of excellent pedestrian infrastructures which help to increase the use of urban public transport.

3 . METHODOLOGY

There are four components of data required; trip-maker characteristics, perception on LRT services and walkability, level of satisfaction, and agreement on the element of pedestrian infrastructures. Trip-maker characteristics consist of gender, ethnicity, age, marital status, income, employability status, vehicle ownership, number of households, number of frequency using LRT, and reasons for using LRT. Perception on LRT services and walkability consists of the frequency of using LRT, some single and return trip, the reason for using LRT, the frequency of walking LRT station, the time required to access LRT station, and reason to

walk. Level of satisfaction on the pedestrian infrastructures includes the provision of continuous, wide, direct connectivity walkways, crossing, roof, benches, lighting, and signage. Overall satisfaction on the pedestrian infrastructures designs was also included. Level of agreement on pedestrian infrastructures covers walkways connectivity, continuity, wide, covered, obstruction-free, crossing, landscape features, benches, signages, lighting, and security camera. Level of satisfaction and agreement were ranked in ordinal scale between 1 to 5 in which number 1 is referred to as "extremely dissatisfied," and number 5 is referred to as "extremely satisfied."

The passerby who accesses the selected LRT stations were asked to complete a set of the questionnaire on trip-maker characteristics, perception on LRT services and walkability, level of satisfaction and agreement on the element of pedestrian infrastructures. There is 70 respondents at Kerinchi LRT station, 123 respondents at Wangsa Maju LRT station, 238 respondents at Taman Paramount LRT station, 75 respondents at Bukit Jalil LRT station, 322 respondents at Pandan Jaya LRT station, 271 respondents at Sentul LRT station were surveyed. The total sample size is 431 for the Kelana Jaya line and 456 for the Ampang line. The respondents were approached by a convenience sample in which the passerby who accesses to the LRT stations by walking was asked to fill up the survey form.

For univariate analysis, trip-maker characteristics, the perception of walkability, and the use of LRT services were analyzed by frequency distribution tables. For bivariate analysis, all variables include trip-maker characteristics, perception on walkability and the use of LRT services, level of satisfaction and level of agreement on pedestrian infrastructures designs elements were analyzed by a Pearson correlation matrix table to discover any potential relationship to the frequency of walking to LRT station. For multivariate, level of satisfaction and agreement on pedestrian infrastructures designs were analyzed by Relative Importance Index (RII). RII or can also be known as the weighted average analysis is the term where the weight stands for the importance of different items and various ranks (Almaraj, 2011). According to Johnson and LeBreton (2004), RII was used in finding the contribution a particular variable makes to the prediction of a criterion variable both by itself and in combination with other predictor variables. In calculating the Relative Importance Index (RII), the formula used as follow (Badu, E. et al. (2013) :

$$\text{RII} = \frac{\sum W}{A * N}$$

Where W = weights given to each statement by the respondents and ranges from 1 to 5,
A = Higher response integer (5) and
N = total number of respondents.

The binary logistics regression was conducted based on the result of correlation matrix table. All correlated variables to "frequency of walking to LRT station" were used in the binary logistics regression. All variables correlated variables were the first dummy coded into 0-1 before the model was generated.

4 . ANALYSIS AND FINDINGS

4.1 Trip-Maker Characteristics

Table 1 showed the trip-maker characteristics of the respondent who access LRT stations by walking. For both LRT lines; Ampang and Kelana Jaya, data shows there is almost equal response rate given based on gender, however in terms of ethnicity, the Malay is dominant as

compared to another ethnicity. Those who access LRT station by walking mostly age between 18 to 34 years old (young adults), unmarried, earn low income (below RM3000 per month), employed except for Pandan Jaya station which has a higher number of students. They also mostly live in a high number of households with no vehicle ownership except for Kerinchi and Taman Paramount stations.

Table 1 Trip-Maker Characteristics of respondents who access LRT stations by walking

Category	Variable	Kelana Jaya						Ampang					
		Kerinchi		Wangsa Maju		Taman Paramount		Sentul		Pandan Jaya		Bukit Jalil	
		f	%	f	%	f	%	f	%	f	%	f	%
Gender	Male	26	37.14	64	52.03	97	40.76	137	50.55	89	27.64	42	56.76
	Female	44	62.86	59	47.97	141	59.24	134	49.45	233	72.36	32	43.24
Ethnicity	Malay	39	55.71	79	64.23	123	51.68	175	64.81	271	84.69	30	40.54
	Chinese	18	25.71	29	23.58	62	26.05	41	15.19	26	8.13	25	33.78
	Indian	13	18.57	15	12.20	53	22.27	43	15.93	17	5.31	9	12.16
	Other	0	0.00	0	0.00	0	0.00	11	4.07	6	1.88	10	13.51
Age group	13 to 17	5	7.14	28	22.76	4	1.68	55	20.30	24	7.48	9	12.00
	18 to 24	8	11.43	44	35.77	93	39.08	109	40.22	276	85.98	35	46.67
	25 to 34	30	42.86	35	28.46	103	43.28	66	24.35	11	3.43	14	18.67
	35 to 44	10	14.29	7	5.69	32	13.45	23	8.49	6	1.87	9	12.00
	45 to 54	10	14.29	5	4.07	6	2.52	11	4.06	2	0.62	5	6.67
	55 to 64	7	10.00	3	2.44	0	0.00	4	1.48	1	0.31	1	1.33
	65 and above	0	0.00	1	0.81	0	0.00	3	1.11	1	0.31	2	2.67
Marital Status	Single	33	47.14	84	68.29	137	57.56	213	78.60	310	97.18	56	74.67
	Married	31	44.29	34	27.64	99	41.60	55	20.30	9	2.82	17	22.67
	Widowed	6	8.57	5	4.07	2	0.84	2	0.74	0	0.00	0	0.00
	Divorced	0	0.00	0	0.00	0	0.00	1	0.37	0	0.00	2	2.67
Income range per month (RM)	< RM1000	11	15.71	60	48.78	4	1.68	139	51.48	271	88.56	46	63.01
	1001 - 2000	10	14.29	36	29.27	32	13.45	83	30.74	20	6.54	11	15.07
	2001 - 3000	34	48.57	19	15.45	115	48.32	30	11.11	7	2.29	9	12.33
	3001 - 4000	12	17.14	6	4.88	61	25.63	8	2.96	2	0.65	3	4.11
	4001 - 5000	3	4.29	0	0.00	16	6.72	5	1.85	1	0.33	2	2.74
	5001 - 6000	0	0.00	1	0.81	10	4.20	2	0.74	2	0.65	1	1.37
	6001 - 7000	0	0.00	0	0.00	0	0.00	2	0.74	1	0.33	1	1.37
	7001 - 8000	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	8001 - 9000	0	0.00	0	0.00	0	0.00	1	0.37	0	0.00	0	0.00
	9001 - 10000	0	0.00	1	0.81	0	0.00	0	0.00	0	0.00	0	0.00
	> RM10000	0	0.00	0	0.00	0	0.00	0	0.00	2	0.65	0	0.00
Employability status	Student	9	12.86	59	47.97	5	2.10	120	44.28	290	90.06	40	53.33
	Employed	55	78.57	54	43.90	232	97.48	141	52.03	24	7.45	29	38.67
	Housewife	6	8.57	2	1.63	1	0.42	4	1.48	2	0.62	0	0.00
	Unemployed	0	0.00	4	3.25	0	0.00	5	1.85	5	1.55	4	5.33
	Retired	0	0.00	1	0.81	0	0.00	1	0.37	0	0.00	2	2.67
	Other	0	0.00	3	2.44	0	0.00	0	0.00	1	0.31	0	0.00

Number of households	One	3	4.29	3	2.44	2	0.84	11	4.10	10	3.13	11	14.67
	Two	9	12.86	14	11.38	13	5.46	16	5.97	16	5.02	7	9.33
	Three	13	18.57	26	21.14	43	18.07	38	14.18	19	5.96	13	17.33
	Four	23	32.86	32	26.02	110	46.22	68	25.37	55	17.24	19	25.33
	Five	15	21.43	21	17.07	54	22.69	62	23.13	50	15.67	12	16.00
	Six and above	7	10.00	27	21.95	16	6.72	73	27.24	169	52.98	13	17.33
Private vehicle ownership	No	23	32.86	74	60.16	12	5.04	198	73.06	281	87.27	52	70.27
	Yes	47	67.14	49	39.84	226	94.96	73	26.94	41	12.73	22	29.73

4.2 Perception of the Use of LRT Services and Walkability

Table 2 showed the LRT services and walkability levels perceived by those who access LRT station by walking. Data shows that the respondents frequently walk in weekday for two-ways directions. The main reasons for using LRT are “I have no vehicle in household”, “I can save money using LRT services”, “I can save time using LRT services”, “I want to avoid traffic congestion”, “I found LRT station near to my place”, and “I found LRT services are safe”. There are two significant reasons for walking to LRT station, which is “No car” and “Near to my origin.” There are two similar reasons for using LRT and walk to access LRT station, which is no vehicle ownership and near access to LRT station. It also indicates that the relevant LRT services due to time and cost saving, road congestion, and safety.

Table 2 Perception of the use of LRT services and walkability

Category	Variable	Kelana Jaya						Ampang					
		Kerinchi		Wangsa Maju		Taman Paramount		Sentul		Pandan Jaya		Bukit Jalil	
		f	%	f	%	f	%	f	%	f	%	f	%
Frequency of using LRT per week	One day	15	21.43	32	26.02	1	0.42	32	11.99	75	23.89	15	20.00
	Two days	13	18.57	6	4.88	3	1.26	19	7.12	38	12.10	4	5.33
	Three days	5	7.14	4	3.25	0	0.00	14	5.24	30	9.55	9	12.00
	Four days	4	5.71	3	2.44	2	0.84	18	6.74	21	6.69	7	9.33
	Five days	24	34.29	22	17.89	152	63.87	90	33.71	94	29.94	25	33.33
	Six days	8	11.43	32	26.02	61	25.63	60	22.47	20	6.37	9	12.00
	Seven days	1	1.43	24	19.51	19	7.98	34	12.73	36	11.46	6	8.00
One or Two-way trip	One way	0	0.00	28	22.76	1	0.42	24	8.96	40	13.84	6	8.11
	Two ways	70	100.00	95	77.24	237	99.58	244	91.04	247	85.47	68	91.89
	More than two ways	0	0.00	0	0.00	0	0.00	0	0.00	2	0.69	0	0.00
Reason for using LRT	I have no vehicle in household	19	5.18	43	20.19	8	0.97	105	10.07	170	20.99	30	17.24
	I can't drive	11	3.00	25	11.74	6	0.73	54	5.18	58	7.16	14	8.05
	I can save money using LRT services	50	13.62	14	6.57	37	4.47	117	11.22	104	12.84	13	7.47
	I can save time using LRT services	54	14.71	29	13.62	204	24.67	161	15.44	88	10.86	15	8.62
	I found parking fees are high at my destination	28	7.63	12	5.63	13	1.57	24	2.30	17	2.10	5	2.87
	I want to avoid traffic congestion	35	9.54	27	12.68	212	25.63	136	13.04	122	15.06	19	10.92
	I found parking at my destination unavailable	5	1.36	11	5.16	6	0.73	18	1.73	18	2.22	5	2.87
	I found LRT station near to my place	30	8.17	16	7.51	100	12.09	161	15.44	95	11.73	25	14.37

	I found LRT station near to my destination	38	10.35	11	5.16	113	13.66	120	11.51	79	9.75	27	15.52
	I found LRT services are efficient	15	4.09	10	4.69	37	4.47	42	4.03	23	2.84	8	4.60
	I found LRT services are punctual	33	8.99	10	4.69	55	6.65	39	3.74	12	1.48	5	2.87
	I found LRT services are safe	49	13.35	5	2.35	36	4.35	66	6.33	24	2.96	8	4.60
Frequency walking to LRT station per week	Very infrequent (2 days or less)	11	15.71	32	26.02	3	1.26	30	11.58	43	13.48	12	18.46
	Infrequent (3 days)	11	15.71	4	3.25	1	0.42	19	7.34	43	13.48	10	15.38
	Frequent (4-6 days)	42	60.00	49	39.84	217	91.18	117	45.17	95	29.78	19	29.23
	Very frequent (everyday)	6	8.57	38	30.89	17	7.14	93	35.91	138	43.26	24	36.92
Time taken to reach LRT station from origin	1-5 minutes	16	22.86	57	46.34	222	93.28	101	38.85	111	34.69	14	21.54
	6-10 minutes	43	61.43	25	20.33	16	6.72	105	40.38	107	33.44	22	33.85
	11-15 minutes	11	15.71	30	24.39	0	0.00	31	11.92	56	17.50	15	23.08
	More than 15 minutes	0	0.00	11	8.94	0	0.00	23	8.85	46	14.38	14	21.54
Reasons for walking to LRT station	No car	15	8.29	51	25.50	7	1.88	114	18.10	192	31.07	32	32.32
	I can't drive	9	4.97	31	15.50	7	1.88	53	8.41	65	10.52	17	17.17
	Good walking environment	12	6.63	11	5.50	1	0.27	34	5.40	55	8.90	6	6.06
	Parking fees too high near LRT station	8	4.42	18	9.00	6	1.61	14	2.22	18	2.91	3	3.03
	Unavailability of parking near LRT station	3	1.66	12	6.00	28	7.51	58	9.21	70	11.33	6	6.06
	No convenient parking near LRT station	8	4.42	11	5.50	60	16.09	15	2.38	12	1.94	4	4.04
	Near to my origin	49	27.07	21	10.50	194	52.01	152	24.13	102	16.50	15	15.15
	Wide width of pedestrian walkways	11	6.08	10	5.00	6	1.61	38	6.03	13	2.10	1	1.01
	Walkways are provided with rooftop	17	9.39	16	8.00	3	0.80	36	5.71	17	2.75	4	4.04
	Pedestrian walkways are well connected and continuous with adjoining area	13	7.18	13	6.50	37	9.92	36	5.71	31	5.02	2	2.02
	Safe pedestrian crossing	16	8.84	3	1.50	24	6.43	32	5.08	30	4.85	4	4.04
	Appropriate location of pedestrian crossing	8	4.42	0	0.00	0	0.00	26	4.13	8	1.29	4	4.04
	Good landscaping along the pedestrian walkways	12	6.63	3	1.50	0	0.00	22	3.49	5	0.81	1	1.01

4.3 Level of Satisfaction on the Design of the Current Pedestrian Infrastructures

The level of satisfaction on the current pedestrian infrastructures designs was measured by using a 5-point Likert scale ranging from 1, which is “extremely dissatisfied,” to 5 “extremely satisfied.” This response is used to determine the importance of each element of the pedestrian infrastructure by calculating the RII. Based on cumulative RII for each category, the data show that “Provision of wide pedestrian walkways” has the highest rank with 3.78 followed by “Provision of direct connection from adjoining area to LRT station” with RII rank 3.71, “Provision of continuous walkways” and “Overall satisfaction on pedestrian infrastructure connecting origin and the LRT station” have scored RII 3.69.

"Provision of benches at strategic location along the walkways" has a least RII score, which is 3.48 followed by "Provision of pedestrian walkways with shades/ roof (RII 3.55), "Provision of illuminated street lighting at night along pedestrian walkways near LRT station" (RII 3.56), "Provision of pedestrian crossings at appropriate location" (RII 3.68). These are the elements need for improvement in order to encourage more walking to access LRT stations due to adequate low levels, which influenced RII scores. Based on LRT station, Sentul has found the highest RII score for all pedestrian infrastructures, and they are mostly satisfied.

Table 3 Level of satisfaction on the design of the current pedestrian infrastructures

		Kelana Jaya						Ampang					
		Kerinchi		Wangsa Maju		Taman Paramount		Sentul		Pandan Jaya		Bukit Jalil	
Category	Variable	f	%	f	%	f	%	f	%	f	%	f	%
Provision of continuous walkways	Extremely dissatisfied	7	10.00	8	6.50	6	2.52	9	3.46	8	2.51	5	7.81
	Dissatisfied	16	22.86	40	32.52	121	50.84	19	7.31	39	12.23	4	6.25
	Somehow satisfied	29	41.43	47	38.21	80	33.61	96	36.92	135	42.32	27	42.19
	Satisfied	18	25.71	17	13.82	31	13.03	109	41.92	103	32.29	21	32.81
	Extremely satisfied	0	0.00	11	8.94	0	0	27	10.38	34	10.66	7	10.94
	RII	0.57		0.57		0.51		0.70		0.67		0.67	
Provision of pedestrian crossings at appropriate location	Extremely dissatisfied	7	10.00	8	6.50	6	2.52	7	2.69	5	1.58	3	4.69
	Dissatisfied	16	22.86	40	32.52	121	50.84	35	13.46	32	10.13	8	12.50
	Somehow satisfied	29	41.43	47	38.21	80	33.61	79	30.38	141	44.62	26	40.63
	Satisfied	18	25.71	17	13.82	31	13.03	110	42.31	105	33.23	22	34.38
	Extremely satisfied	0	0.00	11	8.94	0	0.00	29	11.15	33	10.44	5	7.81
	RII	0.57		0.57		0.51		0.69		0.68		0.66	
Provision of wide pedestrian walkways	Extremely dissatisfied	3	4.29	17	13.82	1	0.42	7	2.70	8	2.61	3	4.69
	Dissatisfied	14	20.00	29	23.58	113	47.48	26	10.04	43	14.01	8	12.50
	Somehow satisfied	33	47.14	49	39.84	93	39.08	79	30.50	126	41.04	21	32.81
	Satisfied	12	17.14	13	10.57	31	13.03	114	44.02	97	31.60	23	35.94
	Extremely satisfied	8	11.43	15	12.20	0	0.00	33	12.74	33	10.75	9	14.06
	RII	0.62		0.57		0.53		0.71		0.67		0.68	
Provision of a direct connection from adjoining area to LRT station	Extremely dissatisfied	4	5.71	31	25.20	5	2.10	8	3.09	5	1.61	5	7.81
	Dissatisfied	13	18.57	27	21.95	99	41.60	27	10.42	39	12.54	5	7.81
	Somehow satisfied	29	41.43	37	30.08	102	42.86	79	30.50	130	41.80	27	42.19
	Satisfied	23	32.86	19	15.45	32	13.45	112	43.24	106	34.08	21	32.81
	Extremely satisfied	1	1.43	9	7.32	0	0.00	33	12.74	31	9.97	6	9.38
	RII	0.61		0.52		0.54		0.70		0.68		0.66	
Provision of segregated pedestrian crossing over a busy road near LRT station	Extremely dissatisfied	9	12.86	9	7.32	14	5.88	8	3.13	6	1.95	3	4.62
	Dissatisfied	11	15.71	38	30.89	106	44.54	32	12.50	40	12.99	12	18.46
	Somehow satisfied	35	50.00	53	43.09	95	39.92	90	35.16	141	45.78	29	44.62
	Satisfied	14	20.00	11	8.94	23	9.66	99	38.67	96	31.17	16	24.62
	Extremely satisfied	1	1.43	12	9.76	0	0.00	27	10.55	25	8.12	5	7.69
	RII	0.56		0.57		0.51		0.68		0.66		0.62	
Provision of pedestrian walkways	Extremely dissatisfied	7	10.00	20	16.26	87	36.55	10	3.88	16	5.23	5	7.81
	Dissatisfied	14	20.00	27	21.95	74	31.09	26	10.08	39	12.75	11	17.19

with shades/ roof	Somehow satisfied	27	38.57	49	39.84	57	23.95	86	33.33	111	36.27	25	39.06
	Satisfied	18	25.71	14	11.38	18	7.56	108	41.86	106	34.64	16	25.00
	Extremely satisfied	4	5.71	13	10.57	2	0.84	28	10.85	34	11.11	7	10.94
	RII	0.59		0.56		0.41		0.69		0.67		0.63	
Provision of benches at a strategic location along the walkways	Extremely dissatisfied	4	5.71	10	8.13	49	20.59	14	5.43	20	6.51	5	7.69
	Dissatisfied	18	25.71	45	36.59	103	43.28	47	18.22	57	18.57	11	16.92
	Somehow satisfied	32	45.71	38	30.89	62	26.05	86	33.33	114	37.13	26	40.00
	Satisfied	13	18.57	18	14.63	22	9.24	90	34.88	87	28.34	20	30.77
	Extremely satisfied	3	4.29	12	9.76	2	0.84	21	8.14	29	9.45	3	4.62
	RII	0.58		0.56		0.45		0.64		0.63		0.62	
Provision of illuminated street lighting at night along pedestrian walkways near LRT station	Extremely dissatisfied	6	8.57	21	17.07	34	14.29	14	5.45	18	5.84	5	7.81
	Dissatisfied	13	18.57	34	27.64	101	42.44	28	10.89	52	16.88	9	14.06
	Somehow satisfied	36	51.43	36	29.27	80	33.61	84	32.68	119	38.64	26	40.63
	Satisfied	13	18.57	21	17.07	23	9.66	107	41.63	91	29.55	19	29.69
	Extremely satisfied	2	2.86	11	8.94	0	0.00	24	9.34	28	9.09	5	7.81
	RII	0.58		0.55		0.48		0.68		0.64		0.63	
Provision of clear signage to help pedestrian to get precise information	Extremely dissatisfied	5	7.14	15	12.20	26	10.92	11	4.30	18	5.84	5	7.81
	Dissatisfied	20	28.57	38	30.89	109	45.80	35	13.67	62	20.13	7	10.94
	Somehow satisfied	31	44.29	44	35.77	75	31.51	86	33.59	115	37.34	31	48.44
	Satisfied	11	15.71	15	12.20	26	10.92	99	38.67	86	27.92	16	25.00
	Extremely satisfied	3	4.29	11	8.94	2	0.84	25	9.77	27	8.77	5	7.81
	RII	0.56		0.55		0.49		0.67		0.63		0.63	
Provision of a pedestrian traffic light at the pedestrian crossing	Extremely dissatisfied	5	7.14	16	13.01	37	15.55	16	6.25	21	6.82	11	17.19
	Dissatisfied	12	17.14	40	32.52	114	47.90	32	12.50	53	17.21	6	9.38
	Somehow satisfied	33	47.14	44	35.77	67	28.15	77	30.08	116	37.66	24	37.50
	Satisfied	12	17.14	14	11.38	18	7.56	101	39.45	92	29.87	16	25.00
	Extremely satisfied	8	11.43	9	7.32	2	0.84	30	11.72	26	8.44	7	10.94
	RII	0.62		0.53		0.46		0.68		0.63		0.61	
Overall satisfaction on pedestrian infrastructure connecting origin and the LRT station	Extremely dissatisfied	6	8.57	24	19.51	11	4.62	6	2.32	13	4.08	2	3.08
	Dissatisfied	15	21.43	22	17.89	156	65.55	21	8.11	26	8.15	3	4.62
	Somehow satisfied	23	32.86	44	35.77	46	19.33	83	32.05	143	44.83	31	47.69
	Satisfied	24	34.29	27	21.95	21	8.82	129	49.81	119	37.30	20	30.77
	Extremely satisfied	2	2.86	6	4.88	4	1.68	20	7.72	18	5.64	9	13.85
	RII	0.60		0.55		0.47		0.71		0.66		0.70	

4.4 Level of Agreement on the Elements of Pedestrian Infrastructure for an Enjoyable Walking to the Transit Station

The respondents were asked to rate their level of agreement on the elements of pedestrian infrastructure for an enjoyable walking to the transit station. The level of agreement was measured by using a 5-point Likert scale ranging from 1 “strongly disagree” to 5 “strongly agree.” The responses were then ranked by using the relative importance index (RII) to determine the level of importance of each element of pedestrian infrastructure. Table 4 showed that the level of agreement to make walking more enjoyable by “Covered pedestrian walkways” (RII 5.09), followed by “Illuminated street lighting at night near LRT station” (RII 5.03), “Obstruction free of pedestrian walkways” (RII 5.02) and “Well-connected pedestrian

walkways" (RII 5.00). These are the elements that need to be considered to make more enjoyable walking to access LRT stations.

The relatively less important element for enjoyable walking to LRT stations are "Attractive landscape features/ elements along pedestrian walkways" (RII 4.90), followed by "Provision of benches at strategic location along the pedestrian walkways" (RII 4.94), "Appropriate location of pedestrian crossing at road level" (4.96), "Provision of pedestrian signage at strategic location near LRT station" (4.97), "Continuous pedestrian walkways" (RII 4.97. The other elements which are considered averagely necessary are "Elevated pedestrian walkways over a busy road with escalators" (RII 4.98), and "Wide pedestrian walkways" (RII 4.99).

Table 4 Level of agreement on the elements of pedestrian infrastructure for an enjoyable walking to the transit station

		Kelana Jaya						Ampang					
		Kerinchi		Wangsa Maju		Taman Paramount		Sentul		Pandan Jaya		Bukit Jalil	
Category	Variable	f	%	f	%	f	%	f	%	f	%	f	%
Well-connected pedestrian walkways	Strongly disagree	0	0.00	3	2.44	0	0.00	1	0.38	6	1.88	2	3.13
	Disagree	0	0.00	4	3.25	0	0.00	9	3.46	16	5.02	8	12.50
	Somehow agree	5	7.14	27	21.95	0	0.00	30	11.54	106	33.23	19	29.69
	Agree	15	21.43	29	23.58	111	46.64	91	35.00	106	33.23	21	32.81
	Strongly agree	50	71.43	60	48.78	127	53.36	127	48.85	83	26.02	14	21.88
	RII	0.93		0.83		0.91		0.86		0.75		0.72	
Continuous pedestrian walkways	Strongly disagree	0	0.00	1	0.81	0	0.00	0	0.00	3	0.95	1	1.56
	Disagree	0	0.00	5	4.07	0	0.00	9	3.46	23	7.28	9	14.06
	Somehow agree	4	5.71	23	18.70	0	0.00	28	10.77	114	36.08	20	31.25
	Agree	35	50.00	36	29.27	81	34.03	103	39.62	101	31.96	20	31.25
	Strongly agree	31	44.29	58	47.15	157	65.97	119	45.77	76	24.05	14	21.88
	RII	0.88		0.84		0.93		0.86		0.74		0.72	
Wide pedestrian walkways	Strongly disagree	0	0.00	1	0.81	0	0.00	0	0.00	3	0.98	2	3.13
	Disagree	0	0.00	6	4.88	0	0.00	6	2.32	18	5.86	6	9.38
	Somehow agree	4	5.71	21	17.07	0	0.00	39	15.06	116	37.79	18	28.13
	Agree	31	44.29	36	29.27	67	28.15	99	38.22	97	31.60	21	32.81
	Strongly agree	35	50.00	59	47.97	171	71.85	115	44.40	72	23.45	15	23.44
	RII	0.89		0.84		0.94		0.85		0.74		0.73	
Covered pedestrian walkways	Strongly disagree	0	0.00	1	0.81	0	0.00	1	0.39	2	0.64	2	3.13
	Disagree	0	0.00	5	4.07	0	0.00	9	3.47	17	5.47	6	9.38
	Somehow agree	2	2.86	23	18.70	0	0.00	28	10.81	104	33.44	18	28.13
	Agree	34	48.57	35	28.46	6	2.52	92	35.52	95	30.55	21	32.81
	Strongly agree	34	48.57	59	47.97	232	97.48	126	48.65	92	29.58	16	25.00
	RII	0.89		0.84		0.99		0.86		0.77		0.74	
Obstruction-free of pedestrian walkways	Strongly disagree	0	0.00	2	1.63	0	0.00	2	0.78	2	0.65	3	4.62
	Disagree	0	0.00	5	4.07	0	0.00	5	1.95	20	6.49	7	10.77
	Somehow agree	5	7.14	23	18.70	0	0.00	38	14.84	110	35.71	17	26.15
	Agree	21	30.00	35	28.46	47	19.75	77	30.08	93	30.19	23	35.38
	Strongly agree	44	62.86	58	47.15	191	80.25	135	52.73	86	27.92	13	20.00

	RII	0.91		0.83		0.96		0.86		0.75		0.71	
Elevated pedestrian walkways over the busy road with escalators	Strongly disagree	0	0.00	1	0.81	0	0.00	1	0.39	7	2.29	4	6.25
	Disagree	0	0.00	8	6.50	0	0.00	8	3.10	28	9.15	6	9.38
	Somehow agree	2	2.86	23	18.70	2	0.84	33	12.79	112	36.60	20	31.25
	Agree	27	38.57	32	26.02	64	26.89	89	34.50	89	29.08	19	29.69
	Strongly agree	41	58.57	59	47.97	172	72.27	126	48.84	77	25.16	15	23.44
	RII	0.91		0.83		0.94		0.86		0.73		0.71	
Appropriate location of the pedestrian crossing at road level	Strongly disagree	0	0.00	2	1.63	0	0.00	0	0.00	5	1.63	2	3.08
	Disagree	0	0.00	3	2.44	0	0.00	8	3.10	12	3.91	8	12.31
	Somehow agree	9	12.86	26	21.14	2	0.84	35	13.57	122	39.74	20	30.77
	Agree	25	35.71	33	26.83	76	31.93	79	30.62	101	32.90	20	30.77
	Strongly agree	36	51.43	59	47.97	160	67.23	135	52.33	70	22.80	13	20.00
	RII	0.88		0.83		0.93		0.87		0.74		0.71	
Attractive landscape features/ elements along pedestrian walkways	Strongly disagree	0	0.00	3	2.44	0	0.00	2	0.78	7	2.27	4	6.25
	Disagree	1	1.43	12	9.76	0	0.00	14	5.45	31	10.06	8	12.50
	Somehow agree	1	1.43	19	15.45	4	1.68	30	11.67	114	37.01	20	31.25
	Agree	28	40.00	30	24.39	71	29.83	86	33.46	93	30.19	20	31.25
	Strongly agree	40	57.14	59	47.97	163	68.49	125	48.64	64	20.78	12	18.75
	RII	0.91		0.81		0.93		0.85		0.71		0.69	
Provision of benches at a strategic location along the pedestrian walkways	Strongly disagree	0	0.00	4	3.25	0	0.00	5	1.95	9	2.92	2	3.13
	Disagree	1	1.43	8	6.50	0	0.00	6	2.34	32	10.39	10	15.63
	Somehow agree	0	0.00	21	17.07	0	0.00	43	16.80	99	32.14	24	37.50
	Agree	25	35.71	29	23.58	80	33.61	78	30.47	93	30.19	12	18.75
	Strongly agree	44	62.86	61	49.59	158	66.39	125	48.83	78	25.32	17	26.56
	RII	0.92		0.82		0.93		0.84		0.73		0.70	
Provision of pedestrian signage at strategic location near LRT station	Strongly disagree	0	0.00	4	3.25	0	0.00	1	0.39	7	2.27	3	4.69
	Disagree	1	1.43	10	8.13	0	0.00	11	4.30	28	9.09	6	9.38
	Somehow agree	1	1.43	17	13.82	0	0.00	26	10.16	105	34.09	21	32.81
	Agree	30	42.86	33	26.83	66	27.73	87	33.98	100	32.47	20	31.25
	Strongly agree	38	54.29	59	47.97	172	72.27	132	51.56	73	23.70	15	23.44
	RII	0.90		0.82		0.94		0.86		0.73		0.72	
Illuminated street lighting at night near LRT station	Strongly disagree	0	0.00	6	4.88	0	0.00	3	1.16	9	2.82	1	1.54
	Disagree	0	0.00	6	4.88	0	0.00	12	4.63	32	10.03	8	12.31
	Somehow agree	2	2.86	18	14.63	0	0.00	18	6.95	100	31.35	22	33.85
	Agree	19	27.14	34	27.64	42	17.65	89	34.36	86	26.96	18	27.69
	Strongly agree	49	70.00	59	47.97	196	82.35	135	52.12	86	26.96	15	23.08
	RII	0.93		0.82		0.96		0.87		0.73		0.72	
Provision of a security camera near LRT station	Strongly disagree	0	0.00	7	5.69	0	0.00	5	1.93	14	4.39	2	3.08
	Disagree	0	0.00	7	5.69	0	0.00	13	5.02	23	7.21	11	16.92
	Somehow agree	6	8.57	14	11.38	0	0.00	22	8.49	99	31.03	17	26.15
	Agree	24	34.29	37	30.08	47	19.75	72	27.80	72	22.57	18	27.69
	Strongly agree	40	57.14	58	47.15	191	80.25	145	55.98	103	32.29	16	24.62
	RII	0.90		0.81		0.96		0.86		0.75		0.71	

5 FREQUENCY OF WALKING TO LRT STATIONS AND OTHER VARIABLES

Table 5 showed the variables which correlated to the "frequency of walking to LRT station." It is pronounced there is a higher number of variables correlated for Kelana Jaya line data as compared to the Ampang line. The Pearson correlation coefficient was used to indicate the strength with significant value .05. There are nine variables correlated to the "frequency of walking to LRT station" for Ampang line and another 25 variable correlated to the "frequency of walking to LRT station" for Kelana Jaya line.

Table 5 Correlated variables to the "frequency of walking to LRT station."

Ampang line			Kelana Jaya line								
Variable		Value	Variable		Value	Variable		Value	Variable		Value
Private vehicle ownership	R	-0.15		R	-0.11	Unavailability of Parking	R	-0.14	Provision segregated crossing	R	0.21
	P	0.00	Income range	P	0.03		P	0.00		P	0.00
Car	R	-0.11		R	-0.10	Avoid Traffic Congestion	R	-0.17	Provision walkways rooftop	R	0.19
	P	0.00	Van	P	0.04		P	0.00		P	0.00
Motorcycle	R	-0.14	Provision direct connection	R	0.19		R	-0.12	Provision benches	R	0.20
	P	0.00		P	0.00	Near To Origin	P	0.02		P	0.00
Frequency of using LRT per week	R	0.47		R	0.13	Safe Pedestrian Crossing	R	0.11	Provision street lighting	R	0.17
	P	0.00	Provision benches walkways	P	0.01		P	0.03		P	0.00
One or Two-way trip	R	0.21		R	-0.70	Good Landscaping	R	0.11	Provision signage	R	0.14
	P	0.00	Frequency use of LRT per week	P	0.00		P	0.03		P	0.01
I have no vehicle in the household	R	0.10		R	0.16	Provision continuous walkways	R	0.23	Provision traffic light	R	0.18
	P	0.01	No vehicle	P	0.00		P	0.00		P	0.00
I found parking fees are high at my destination	R	0.08		R	-0.13	Provision pedestrian crossing	R	0.26	Overall satisfaction	R	0.15
	P	0.05	Save time	P	0.01		P	0.00		P	0.00
I want to avoid traffic congestion	R	0.10		R	-0.11	Provision wide walkways	R	0.20	Well-connected walkways	R	0.10
	P	0.01	LRT is efficient	P	0.02		P	0.00		P	0.04
No car	R	0.14		R	0.10						
	P	0.00	No Car	P	0.05						

Note: R; Pearson correlation coefficient, P; p-value significant level at .05

6 PREDICTING FREQUENCY OF WALKING TO LRT STATION BY BINARY LOGISTICS REGRESSION

The binary logistics regression was used to identify predictors for "frequency of walking to LRT station." For Ampang line stations, there are nine variables correlated to "frequency of walking to LRT stations." The Omnibus Tests of Model Coefficients showed that the statistically significant model p-value of .000 (<.005). The Cox & Snell R Square is .255, and Nagelkerke R Square is .387. The Hosmer and Lemeshow Test were found to be statistically insignificant .695 (>.005) and Chi-square 5.568, which illustrates the goodness of fit. Classification Table showed 95.0% of the model is correct in predicting "frequent walk to LRT station" and 37.0% in predicting the "infrequent walk to LRT station" by the participants. The model also stated 81.6% of its model is correct in predicting both the frequently and infrequently walking to LRT station. Refer to Appendix 1 to 4.

Variables in the Equation showed that "Frequency of using LRT," "Two-way trips," "Avoid traffic congestion" were three variables statistically significant in predicting

"frequency of walking to LRT station." Based on Exp(B) values, there indicates those who are frequently using LRT in a week has 12.289 times more likely to frequently walk to LRT stations than those who are less using LRT in a week. Secondly, it showed that those who took return LRT trips (two ways or more) were three times more likely to frequently walk to LRT station than those who took one way LRT trip. The model also showed that "those who want to avoid traffic congestion" is 2.281 times more likely to frequently walk to LRT station than those who did not want to avoid traffic congestion. Refer to Appendix 5.

For Kelana Jaya line stations, there are 25 variables correlated to "frequency of walking to LRT stations." The Omnibus Tests of Model Coefficients showed that the statistically significant model p-value of .000 (<.005). The Cox & Snell R Square is .396, and Nagelkerke R Square is .702. The Hosmer and Lemeshow Test were found to be statistically insignificant .479 (>.005) and Chi-square 7.551, which illustrates the goodness of fit. Classification Table showed 96.1% of the model is correct in predicting "frequent walk to LRT station" and 80.3% in predicting the "infrequent walking to LRT station" by the participants. The model also stated 93.8% of its model is correct in predicting both the frequently and infrequently walking to LRT station. Refer to Appendix 6 to 9.

Variables in the Equation for each predicted variables showed that "Frequency of using LRT," "Near To Origin," "Safe Pedestrian Crossing," "and Provision of segregated crossing" were four variables statistically significant in predicting "frequency of walking to LRT station." Based on Exp(B) values, there indicates those who are "frequently using LRT in a week" has 71.689 times more likely to frequently walk to LRT stations than those who are less using LRT in a week. Secondly, it showed that the "near to origin" is 9.426 times more likely to increase frequently walk to LRT station and "Safe Pedestrian Crossing" is .122 times more likely to increase frequently walk to LRT station. The model also showed that the "Provision of segregated crossing" is .104 times more likely to walk to LRT station than poorly connected pedestrian walkways frequently. Refer to Appendix 10.

7 DISCUSSION AND CONCLUSION

The young adults, unmarried, and low income are the main characteristics of the users who access the LRT station by walking. Therefore, the LRT operator should be able to attract these group by ticket incentive, or likewise: indirectly encouraging walking and the use of pedestrian infrastructures. There are six factors of using LRT, such as no vehicle ownership, save money, save time, avoiding traffic congestion, short distance, and safety. The main concern for improvement based on satisfaction levels of respondents are the provision of benches, roofed walkway, lighting, and appropriate location for crossing.

Based on binary logistics regression result, "Frequency of using LRT," "Two-way trips," "Avoid traffic congestion," "Near To Origin," "Safe Pedestrian Crossing," "and Provision of segregated crossing" are statistically significant in predicting "frequency of walking to LRT station." Thus, the improvement of LRT services which may encourage more trips. Residential and offices should be a plan and location near to LRT stations to encourage walking to the station and subsequently able to increase public transport ridership and reduce dependency on automobiles.

The LRT operation administrator as well as the government to take into consideration in order to encourage pedestrian-based LRT passengers to walk to LRT stations and use LRT as their default medium of transportation. The study showed that it is crucial to attracting the younger age working population as well as students who live within 10 minutes walking distance of LRT station. Others, to provide incentive or discount for return trip ticket,

provision of the well and direct connectivity, continuous, covered, wide, with appropriate crossings pedestrian walkways from origin points to LRT stations. Further study should focus on the better design of pedestrian walkways connecting possible origins and LRT stations to address the dissatisfaction of some respondents on pedestrian infrastructures designs. It could be an exploration of new approaches to walking facilities and concepts mainly to attract more users. (Field, 2005; Lau, Phang, & Zainuddin, 2006) (Crowson, 2018; Dr. Todd Grande, 2016)

ACKNOWLEDGMENT

The authors would like to express their sincere appreciations to the Ministry of Higher Education, Government of Malaysia, for providing research funding for this project under the Fundamental Research Grant Scheme (FRGS14-106-0347).

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APPENDICES

Appendix 1 Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	176.080	9	.000
	Block	176.080	9	.000
	Model	176.080	9	.000

Appendix 2 Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	469.479[a]	.255	.387

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Appendix 3 Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	5.568	8	.695

Appendix 4 Classification Table

			Predicted Frequency of walking to LRT station		
	Observed		.00	1.00	Percentage Correct
Step 1	Frequency of walking to LRT station	.00	51	87	37.0
		1.00	23	436	95.0
	Overall Percentage				81.6

a. The cut value is .500

Appendix 5 Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Private vehicle ownership	-1.039	.678	2.347	1	.125	.354
	Car ownership	.029	.622	.002	1	.963	1.029
	Motorcycle ownership	.129	.502	.066	1	.797	1.138
	Frequency of using LRT	**2.509**	**.264**	**89.968**	**1**	**.000**	12.289
	Two way trips	**1.099**	**.323**	**11.543**	**1**	**.001**	3.000
	No vehicle	.034	.302	.013	1	.911	1.034
	High parking charges	.645	.516	1.563	1	.211	1.907
	Avoid traffic congestion	**.825**	**.254**	**10.520**	**1**	**.001**	2.281

	No car	.315	.301	1.098	1	.295	1.370
	Constant	-1.086	.356	9.289	1	.002	.337

a. Variable(s) entered on step 1: pri_own, car_0_1, motor_0_1, fre_lrt_0_1, one_twoway_0_1, no_vehic, fee_high, avoid_tr, no_car.

Appendix 6 Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	211.480	24	.000
	Block	211.480	24	.000
	Model	211.480	24	.000

Appendix 7 Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	136.582[a]	.396	.702

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Appendix 8 Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	7.551	8	.479

Appendix 9 Classification Table

			Predicted		
			Frequency of walking to LRT station		
	Observed		.00	1.00	Percentage Correct
Step 1	Frequency of walking to LRT station	.00	49	12	80.3
		1.00	14	345	96.1
	Overall Percentage				93.8

a. The cut value is .500

Appendix 10 Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Income range	-.547	1.584	.119	1	.730	.579
	Van ownership	18.394	28420.722	.000	1	.999	97345365.066
	Frequency of using LRT	**4.272**	**.593**	**51.938**	**1**	**.000**	**71.689**
	No vehicle	.721	.693	1.082	1	.298	2.056
	Save time	-.178	.634	.079	1	.779	.837
	LRT is efficient	.533	.848	.396	1	.529	1.705
	No Car	.025	.680	.001	1	.971	1.025
	Unavailability of Parking	17.343	5243.138	.000	1	.997	34036528.199
	Avoid Traffic Congestion	1.265	.656	3.718	1	.054	3.545
	Near To Origin	**2.244**	**.644**	**12.140**	**1**	**.000**	**9.426**
	Safe Pedestrian Crossing	**-2.102**	**.851**	**6.097**	**1**	**.014**	**.122**
	Good Landscaping	.279	1.039	.072	1	.789	1.321
	Provision of continuous walkway	-1.548	.924	2.806	1	.094	.213
	Provision of pedestrian crossing	-.060	1.010	.004	1	.953	.942
	Provision of wide walkway	-1.286	1.085	1.403	1	.236	.276
	Provision of direct connection	.671	.943	.505	1	.477	1.955
	Provision of segregated crossing	**-2.262**	**.972**	**5.419**	**1**	**.020**	**.104**
	Provision of roofed walkway	-.252	1.240	.041	1	.839	.777
	Provision of benches	-.613	1.188	.267	1	.606	.541
	Provision of street lighting	1.763	.953	3.419	1	.064	5.828
	Provision of signage	1.374	.915	2.256	1	.133	3.950
	Provision of traffic light	.399	1.286	.096	1	.756	1.491
	Overall satisfaction	-.454	.823	.304	1	.581	.635
	Provision of benches along walkway	-.010	.821	.000	1	.990	.990
	Constant	-.738	1.777	.173	1	.678	.478

a. Variable(s) entered on step 1: incom_rang_0_1, van_0_1, fre_LRT_0_1, No_vehicle, Save_time, LRT_efficient, No_Car, Unavailability_of_Parking, Avoid_Traffic_Congestion, Near_To_Origin, Safe_Pedestrian_Crossing, Good_Landscaping, pro_continuous_0_1, pro_ped_cros_0_1, pro_wide_0_1, pro_direct_0_1, pro_segregated_0_1, pro_roof_0_1, pro_benches_0_1, pro_light_0_1, pro_sign_0_1, pro_trafficlight_0_1, over_sat_0_1, pro_bencheswalkways_0_1.