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RELATIONSHIP BETWEEN LEVEL OF AWARENESS AND WILLINGNESS TO PARTICIPATE IN RECYCLING

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Abstract: Municipal solid waste is increasingly becoming a significant environmental challenge as a result of population growth and rapid development. Accordingly, environmental degradation such as air and water pollution as well as disease spread could happen. Recycling is the best approach to reduce environmental impacts from mismanagement of municipal solid waste. This study focuses on the recycling awareness level and willingness to participate in recycling practices as these two elements are the key factors affecting recycling behavior. Puchong suburban residential area is selected as the study area because most of the waste is generated in residential areas. A total of 424 residents were selected through multistage sampling, a combination of cluster random sampling and simple random sampling to participate in this research. The respondents are surveyed through a mixed-mode method to gather their perspectives towards recycling practices in daily lives. The questionnaires distributed consisted of three sections for socio-demographic background, recycling awareness and willingness to participate, respectively. The results discovered that the residents had a high awareness level of recycling with an overall mean of 4.08. Moreover, the residents were greatly willing to participate in recycling with an overall mean of 4.07. Besides, Kendall's tau-b correlation, r = 0.451 and Spearman rank-order correlation, r = 0.600 showed that there was a moderate correlation between recycling awareness and willingness to participate. Therefore, to encourage the public's participation and contribution towards recycling, local authorities shall continually take decisive actions to promote recycling awareness and disseminate recycling information. In addition, this research contributes to the knowledge of relationship between the two variables.

Keywords: awareness, municipal solid waste, recycling, willingness to participate

Introduction

Since the beginning of civilization, waste has inevitably been produced. According to the Solid Waste and Public Cleansing Management (SWPCM) Act 2007, municipal solid waste (MSW) is defined as any substance required to be disposed of as being broken, worn out, contaminated, or otherwise spoiled. In Malaysia, for the states that adopted the Solid Waste and Public Cleansing Management Act 2007 (Act 672), about 3,108.9 thousand tons of solid wastes are produced in 2019 as compared to 3,098.7 thousand tons in 2018 (Department of Statistics Malaysia, 2020).

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Municipal solid waste management (MSWM) is constantly one of the principal environmental challenges in most of the growing nations, including Malaysia. Unfortunately, the preferred MSW disposal technique in Malaysia is through landfills and most of them are open dumping sites. This is because open dumping landfill is a low-cost and most common practice to deal with MSW containing a high proportion of organic components (Zaipul *et al*., 2015). However, open dumping landfills affect the environment negatively in several ways. One of the most noticeable impacts is surface and groundwater contamination through leachate. Throughout time, incineration is the second widely adopted approach to handle MSW in Malaysia. The effectiveness in managing a diverse MSW is the primary reason people's choice of waste management options. Nonetheless, the combustion-based process for MSW treatment in incineration is always an arguable subject as it releases harmful pollutants such as dioxins into the atmosphere, land and water (Zaipul and Ahmad, 2017). Accordingly, detrimental effects on human health and the natural environment will take place if strict controls are absent in incineration. Undoubtedly, the booming population has caused waste disposal problems to become more challenging. The multiplied amount of MSW generated has caused many environmental issues in the area.

In order to reduce the amount of waste generated and to prevent the environmental issues that arose from it, recycling is the best approach. Musbah Swesi *et al*. (2019) defined recycling as behavior that calls for huge effort from individuals to sort, arrange and stockpile the MSW. It is unquestionable that there is a lack of planning and implementation in accord with the waste management hierarchy of reducing, reusing and recycling (3R) in Malaysia (Chung *et al*., 2019). On account of the alarming statistics of Malaysia's environment, a more sustainable MSWM is crucially required to resolve the situation. Thus, a priority and emphasis must be placed on the practices of 3R, specifically recycling, by all the stakeholders in the society, including the local authority and the public. This study aims to assess the recycling awareness level and willingness to participate in recycling practices as these two elements are the key factors affecting recycling behavior. Furthermore, this study investigates the relationship between the two variables to help the implementation of a more effective and systematic MSWM.

Several past studies had been carried out focusing on the public awareness of recycling in residential areas. Mohd Halim et al. (2018) reported that most of the residents in Iskandar Malaysia of Johor were aware of the benefits of recycling, the objectives of recycling and the knowledge of recycling. But surprisingly, only a small number of the respondents were willing to participate in recycling frequently. On top of that, a set of questionnaires was distributed to attain the respondent's level of awareness on waste recycling in the Penang housing area. The findings revealed that recycling awareness amongst the residents was moderate (65.7%). Despite the MSW generation multiplying due to the growth in the number of households, 77.1% of the residents practiced recycling habitually (Talip *et al*., 2019).

In 2019, Malaysia's recycling rate reached 28.1%, which showed an increase of 3.5 percentage points as compared to 24.6% in 2018 (Department of Statistics Malaysia, 2020). However, this recycling rate was relatively low when compared to other countries in the Asia region such as South Korea and Singapore that recorded recycling rates of 53.7% and 34.0% respectively.

There were several past studies that had been conducted on willingness towards recycling practices. A questionnaire survey among households in Malaysia was conducted to collect information regarding

perception and attitude towards waste management. From the 250 questionnaires distributed in selected areas in Malaysia, Saat (2015) disclosed that the majority (99%) of respondents were aware of a recycling program in their area; however, only less than 30% of them were participating in the programs. Besides, a research on household participation in recycling programs in Iskandar Malaysia Region, Johor had been carried out. In this study, a sample of 300 households were surveyed through random selection. The findings found most of the households (70%) asserted that they were practicing recycling on recyclable materials especially paper and old clothes (Akil *et al*., 2015).

Overall, Malaysians still have only a moderate willingness to participate in recycling, in spite of all the continuous great efforts from the government (Jereme, Alam & Siwar, 2015). It is doubtless that a drastic transformation in habits and attitudes of the Malaysian public is required in order to contribute to the achievement of MSWM in our country (Jereme *et al*., 2019).

Methods

Study Area

The selection of study area situated at suburban residential area in Puchong, the south of the Petaling region, Selangor, Malaysia. There are three traditional villages in Puchong, which are located in Mukim Petaling 1: Kampung Sri Aman, Kampung Batu 12 and Kampung Batu 14.

Figure 1: Map of study areas

(Source: Google Earth, 2021)

Data Collection

In this study, a structured questionnaire was designed to obtain the respondents' socio-demographics information, their awareness and willingness to participate in recycling through several statements in different sections. Section A consisted of six items to obtain general Information related to respondents details such as gender, age, education level status and others, Section B consisted of 15 items that relate to residents' recycling awareness such as related policies and laws, while Section C contained 13 items about residents' willingness to participate in recycling practices. The development of the instrument was performed in three steps—identifying the content domain, generating sample items, and constructing the instrument (Zamanzadeh *et al*., 2014). In this study, the content domain of the construct was identified by literature review.

After the development of the questionnaire, it was validated by validators from both the public and private universities based on their expertise. To obtain validity evidence for which an instrument was used, content validity index (CVI), the most broadly used approach, was adopted in this study. During the evaluation, the validators were requested to rate instrument items in terms of relevance, clarity and its necessity on a 4-point ordinal scale. To reflect the content validity, a minimum S-CVI of 0.8 was suggested by Polit and Beck (2006), while Yaghmaie (2003) recommended that items with CVI of at least 0.75 to be accepted whilst those with CVI less than 0.75 to be removed. To sum up, the content validity for the questionnaire prepared in this research was proven acceptable and practicable as the results of the analysis showed an index of 0.82 and 0.96 for S-CVI/UA and S-CVI/Ave, respectively.

Then, a pilot study was followed subsequently to test the consistency and reliability of the questionnaire. In this study, 10% of the research sample size, as suggested by Connelly (2008), were chosen to complete the pilot study. The respondents were chosen through simple random sampling. The questionnaires were distributed randomly through online to the targeted population. Then, all comments from respondents were taken into consideration and errors would be amended where there were issues observed in the questionnaire. After that, a reliability test was conducted using Cronbach's alpha through the software Statistical Package for the Social Sciences (SPSS). From the results of the reliability test conducted, the internal consistency of 15 items in section B showed 0.798, which was considered as an acceptable level. On the other hand, all the 13 items in section C held an excellent level at 0.919. In short, both the sections of the questionnaire were feasible and ready to be distributed for data collection.

Sampling Size

In this research, the sample size was decided by using Cochran (1977)'s formula. Cochran's formula is considered especially appropriate in situations with large populations. It allows the calculation of an ideal sample size given a desired level of precision, desired confidence level, and the estimated proportion of the attribute present in the population (Uakarn *et al*., 2021). Most importantly, this calculation does not require a known population size, as the most recent data on population size in the study area remains unidentified. Assuming the maximum variability which $p = 0.5$, with a 95% confidence level that gives Z values of 1.96 and 5% for margin error, the calculation for the required sample size will be as follows:

Equation 1: Cochran (1977)'s formula

$$n_0 = \frac{Z^2 pq}{e^2}$$

$$= \frac{(1.96)^2 (0.5)(0.5)}{(0.05)^2}$$

$$= 384.16$$

$$= 385$$

where,

n0 = Sample size

Z = Desired confidence level

p = Population proportion

q = 1-p

e = Margin of error

Therefore, to make sure the validity of this study, at least 385 respondents were needed to participate in the survey. Accordingly, 424 residents from the study area participated in this research.

Sampling Technique

In this study, a multistage sampling method is used to select respondents from the residential area for the questionnaires prepared. Multistage sampling is defined as a sampling method that divides large populations into groups or clusters to enable the sampling process to be more practical during conducting research (Sedgwick, 2015). In this research, there were four sampling stages conducted to create the sample population required. During the first three stages, a cluster random sampling was adopted, as a total population of interest was divided into clusters by geographic regions. A sampling frame of relevant discrete subgroups of states and districts was chosen. In Malaysia, Selangor was selected among other 12 states and 3 federal territories, thereupon Petaling region was chosen from all 9 districts in Selangor state. Next, the regional cluster was further divided into third-stage clusters by neighborhood. From Petaling district, three suburban residential areas were selected. Then, in the final stage, individual subjects were selected as samples from each subgroup by using simple random sampling. The schematic illustration of multistage sampling is depicted in Figure 1 below.

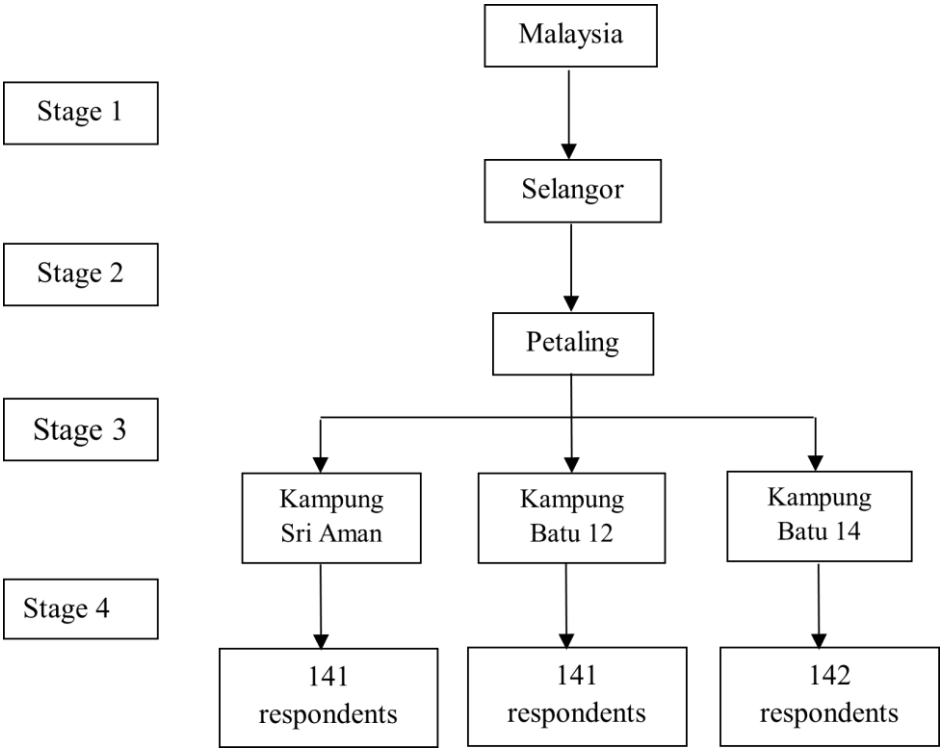

Figure 2: Schematic illustration of multistage sampling

The total number of samples required was divided equally to the three villages to ensure unbiased and equitable results. Accordingly, a lowest number of 141 respondents was necessary from Kampung Sri Aman, Kampung Batu 12 and Kampung Batu 14, respectively. In the meantime, the respondents were chosen by their house numbers through a simple random sampling method. The house numbers of several streets from each village were selected randomly by using an online random number picker.

To distribute the questionnaires, a mixed-mode survey using online and traditional methods was executed. Online survey research benefits in saving time and cost. As already noted, online surveys provide higher access to people with common characteristics in a short amount of time, despite the geographic distances. Aside from online surveys, traditional surveys were also carried out to administer the questionnaires. The respondents were picked through simple random sampling, in which each member of the population had an equal probability of being chosen. By applying the traditional survey through face-to-face approach, the number of respondents from specific communities with poor internet access, illiteracy level limitation and so on could be reduced by a great number. In brief, mixed-mode surveys were implemented to capitalize on greater potential response rates and improve coverage of the population of interest.

Data Analysis

A quantitative research method, a process of collecting and analyzing numerical data, is used in this study. Meanwhile, the Statistical Package for the Social Sciences (SPSS) is used as an analysis tool to analyze the results of the study. After the collection of questionnaires, a screening process was conducted before data entry to ensure the completeness of data. The complete data were keyed in while the incomplete data was eliminated. There are several statistical methods that can be conducted using SPSS to achieve the objectives of this study. First of all, it can perform descriptive statistics like

frequencies and bivariate statistics including means, correlation and nonparametric tests. In this research, nonparametric correlation analyses such as Spearman's rank-order and Kendall's tau-b were performed to identify the associations among the two variables. This was because an ordinal scale was adopted in data collection to gather respondents' degree of agreement with the statements.

Results and Discussion

Recycling Awareness

To measure the level of recycling awareness among the respondents, 15 items were asked in the questionnaire. Each of the items were rated in a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The results on the frequency and percentage of each item for recycling awareness are shown in Table 1 below.

Table 1: Frequency and percentage distribution for awareness

Item	Frequency (Percentage, %)					Mean	SD
	1	2	3	4	5		
I understand that solid waste is a significant global issue.	0 (0.0)	9 (2.1)	39 (9.2)	129 (30.4)	247 (58.3)	4.45	0.748
I am aware that solid waste has impact on climate change.	40 (9.4)	70 (16.5)	93 (21.9)	119 (28.1)	102 (24.1)	3.41	1.274
I know that mismanagement of solid waste can cause harms to public health.	0 (0.0)	11 (2.6)	35 (8.3)	112 (26.4)	266 (62.7)	4.49	0.756
I know that recycling can reduce the amount of solid waste at landfills.	2 (0.5)	5 (1.2)	30 (7.1)	114 (26.9)	273 (64.4)	4.54	0.720
I am aware that recycling helps extend the lifespan of landfills.	2 (0.5)	18 (4.2)	42 (9.9)	107 (25.2)	255 (60.1)	4.40	0.867
I am aware that recycling is important to conserve energy.	4 (0.9)	15 (3.5)	42 (9.9)	109 (25.7)	254 (59.9)	4.40	0.875
I realize that it is important to purchase recyclable products that are environmentally safe.	0 (0.0)	11 (2.6)	51 (12.0)	126 (29.7)	236 (55.7)	4.38	0.796
I know what items can be recycled.	9 (2.1)	24 (5.7)	72 (17.0)	163 (38.4)	156 (36.8)	4.02	0.978
I notice that waste separation is a good way to reduce the amount of solid waste disposal.	2 (0.5)	6 (1.4)	49 (11.6)	130 (30.7)	237 (55.9)	4.40	0.784
I know about solid waste recycling methods and procedures.	18 (4.2)	56 (13.2)	132 (31.1)	104 (24.5)	114 (26.9)	3.57	1.143
I realize the existence of different recycling bins in the community.	7 (1.7)	28 (6.6)	76 (17.9)	106 (25.0)	207 (48.8)	4.13	1.033
I am aware that community recycling program can	4 (0.9)	8 (2.0)	40 (9.4)	126 (29.7)	246 (58.0)	4.42	0.813

contribute towards a cleaner environment.							
I am aware that community recycling program is contributing to increase residents' sense of responsibility towards the environment.	4 (0.9)	11 (2.6)	57 (13.4)	141 (33.3)	211 (49.8)	4.28	0.862
I realize that community recycling program can reduce the cost of solid waste management.	4 (0.9)	21 (5.0)	57 (13.4)	132 (31.1)	210 (49.5)	4.23	0.927
I notice that there is legal enforcement for solid waste management.	124 (29.2)	163 (38.4)	105 (24.8)	25 (5.9)	7 (1.7)	2.12	0.955
Overall mean						4.08	

Note: n = 424 , 1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree

From Table 1, most of the items were rated 5 (strongly agree) with the highest percentage of respondents. For example, there were 64.4% of the respondents strongly agreed that recycling can reduce the amount of solid waste at landfills (item 4), followed by 62.7% for item 3 concerning harms from mismanagement of solid waste and 60.1% for item 5 regarding extension the lifespan of landfills by recycling.

Unlike others, items 2, 8, 10 and 15 were not having the highest percentage of respondents to strongly agree with. For item 2, 28.1% of the respondents agreed that solid waste has an impact on climate change. Although the majority scored only 4 for this item, it was still higher than the mean score 3.41. Besides, there was 38.4% of the respondents agreed that they were able to identify recyclable products (item 8), 31.1% of them were being neutral about the solid waste recycling methods and procedures (item 10), and 38.4% of them disagreed that there was legal enforcement for solid waste management, as stated in item 15. The majority of these three items scored lower than the mean value, which were 4.02, 3.57 and 2.12, respectively.

Besides, none of the respondents rated 1 (strongly disagree) for items 1, 3 and 7, which were regarding the awareness of solid waste as a significant global issue, impacts from mismanagement of solid waste and importance of buying recyclable products, respectively. In contrast to those three items, items 15, 2 and 10 recorded the highest percentage of respondents rating for scale 1 (strongly disagree), which were 29.2%, 9.4% and 4.2%, respectively. Indirectly, this led to the three lowest mean values among the 15 items.

In brief, the respondents were most aware of the reduced amount of solid waste at landfills from recycling (item 4), harms from mismanagement of solid waste (item 3) and solid waste as a significant global issue (item 5), as the mean values of these three items were reported the highest. According to Oxford and Burry-Stock (1995), the low range of the mean's scale is from 1.0 to 2.4; the medium range is between 2.5 and 3.4 and the high range is from 3.5 to 5.0. Therefore, it could be concluded that the respondents were having low awareness on legal enforcement for solid waste management (item 15); medium awareness for the impact of solid waste on climate change (item 2) and recycling

methods and procedures (item 10), while the rest were recorded with high awareness. However, the respondents were revealed to have a high recycling awareness with an overall mean value of 4.08.

There were several past studies focused on awareness and recycling knowledge. For instance, Saat (2015) investigated the householders' behavior knowledge regarding solid waste in Malaysia. In the questionnaires distributed, several questions regarding recycling awareness were prepared. For example, 81% of the respondents did know regarding the law and regulation of waste management. In contrast, the majority of the residents (38.4%) in Puchong suburban area disagreed with the existence of legal enforcement for waste management (item 15). Also, most of the residents (65%) claimed that they did not buy environmentally product (Saat, 2015). Contrary to this study, 55.7% of the residents learnt the importance of purchasing recyclable products that are environmentally safe (item 7). By far the most common sources of information about recycling program for all respondents collectively are television (92%) and local authority (6%), followed by newspaper and friends (1%). However, traditional methods of promotion including media campaigns and newsletters can only achieve a limited level of success in shifting public perception, behavior and attitude.

Despite the difference mentioned above, there were similar results from other past research. Noor (2016) asserted that the majority of the residents (82.6%) in Johor Bahru were aware of the significance of recycling. Meanwhile, in Puchong suburban area, more than 60% of the respondents strongly agreed with the importance of recycling (items 4 and 5). Not only that, 77.5% of residents in Johor Bahru affirmed they knew how to recycle their own solid waste; however, the majority of Puchong suburban residents (38.4%) insisted on being neutral on the knowledge of waste recycling methods and procedures (item 10). Noor (2016) concluded that neighbors and students were the most likely players to encourage others to practice recycling. In other words, people feel obligated to do recycle when they are convinced that recycling is everyone's responsibility, or when they see their neighbors recycling.

Aside from that, Talip *et al*. (2019) declared that most of the residents (65.7%) in the northern region housing area had moderate understanding about recycling. In the meantime, only 34.3% of the respondents were equipped with a good comprehension of the idea of recycling. Accordingly, it could be concluded that all of the respondents understood the recycle concept and none of them acquired poor understanding on recycling. Overall, the results from this study were consistent with past research.

Willingness to Participate in Recycling

To assess the willingness to participate in recycling among the respondents, 13 items were prepared in the questionnaire. The results on the frequency and percentage of each item for willingness to participate are displayed in Table 2.

Table 2: Frequency and percentage distribution for willingness

Item	Frequency (Percentage, %)					Mean	SD
	1	2	3	4	5		
I will practise solid waste separation in everyday life.	6 (1.4)	26 (6.1)	93 (21.9)	185 (43.6)	114 (26.9)	3.88	0.922
I will help promote the importance of solid waste separation.	3 (0.7)	25 (5.9)	99 (23.3)	173 (40.8)	124 (29.2)	3.92	0.906
I will promote recyclable products to people I know.	2 (0.5)	15 (3.5)	95 (22.4)	170 (40.1)	142 (33.5)	4.03	0.863
I would be more interested to know more about recyclable items.	0 (0.0)	17 (4.0)	58 (13.7)	158 (37.3)	191 (45.0)	4.23	0.834
I would use the recycling bins provided in the community.	4 (0.9)	13 (3.1)	36 (8.5)	155 (36.6)	216 (50.9)	4.33	0.831
I would talk with people around me about environmental issues related to solid waste.	13 (3.1)	26 (6.1)	115 (27.1)	142 (33.5)	128 (30.2)	3.82	1.031
I would set a positive environmental example (recycling) for my family and friends to follow.	0 (0.0)	24 (5.7)	66 (15.6)	165 (38.9)	169 (39.9)	4.13	0.875
I am willing to support community recycling/ eco-friendly campaign.	2 (0.5)	8 (1.9)	41 (9.7)	178 (42.0)	195 (46.0)	4.31	0.761
I would like to learn more about the environment through workshops or seminars.	10 (2.4)	16 (3.8)	94 (22.2)	153 (36.1)	151 (35.6)	3.99	0.971
I would be interested in calls that aim to protect the environment from pollution.	28 (6.6)	33 (7.8)	76 (17.9)	147 (34.7)	140 (33.0)	3.80	1.174
I am willing to pay for recycling activities to reduce the problem of environmental pollution.	11 (2.6)	52 (12.3)	111 (26.2)	143 (33.7)	107 (25.2)	3.67	1.063
I will comply with existing regulations, policies and laws that emphasize on solid waste recycling.	1 (0.2)	8 (1.9)	50 (11.8)	134 (31.6)	231 (54.5)	4.38	0.784
I would support proposals for new regulations, policies and laws that emphasize on solid waste recycling.	0 (0.0)	10 (2.4)	44 (10.4)	136 (32.1)	234 (55.2)	4.40	0.769
Overall mean						4.07	

Note: n = 424 , 1 = Strongly disagree, 2 = Disagree, 3 = Not sure, 4 = Agree, 5 = Strongly agree

For the willingness to participate in recycling, more than half of the items were recorded with the largest percentage for scale 4 (agree), while the rest for scale 5 (strongly agree). For example, the respondents were willing to practise solid waste separation (item 1), to help promote the importance

of solid waste separation (item 2) and to promote recyclable products (item 3), with a percentage of 43.6%, 40.8% and 40.1%, respectively.

Other than that, items 13, 12 and 5 were recorded with the greatest percentage of respondents that strongly agreed with. There were 55.2% of the respondents strongly agreed that they would support proposals for new regulations, policies, and laws that emphasize on solid waste recycling (item 13) while 54.5% of them were willing to comply with existing regulations, policies and laws (item 12) and 50.9% of them were prone to use the recycling bins provided (item 5). As all these three items were reported by more than 50% of respondents to strongly agree with, their mean values exhibited as the highest among all 15 items accordingly.

In contrast, most of the respondents strongly disagreed with items 10, 6 and 11. There were 28 from the total respondents strongly disagreed that they would be interested in calls that aim to protect the environment from pollution (item 10), 13 of them strongly disagreed that they would talk with people around them about environmental issues related to solid waste (item 6) and 11 of them were not willing to pay for recycling activities (item 11). Also, the three items were recorded with the lowest mean values.

Apart from that, there was none of the respondents rated 1 (strongly disagree) with items 4, 7 and 13. This implied that all of the respondents were willing to know more about recyclable products (item 4), to set a positive environmental example (item 7) and to support proposals for new regulations, policies and laws that emphasize on solid waste recycling (item 13).

In brief, the respondents were declared having a relatively high willingness to participate in recycling as all of the items recorded a high mean value above 3.5, according to the guidelines established by Oxford and Burry-Stock (1995). Furthermore, the overall mean was recorded as 4.07, which was categorized in the range of high mean value as well.

There was a few previous research aimed to study the willingness to participate in recycling activities at different residential areas. Firstly, a study in Iskandar Malaysia, Johor was carried out by Akil *et al*. (2015), the results showed that the highest percentage of residents (80%) was more likely to participate in waste separation. Among them, those older age groups (45 to 64 years old) were more willing to participate in recycling than the younger ones. The main reason was lack of time and busy (65%), followed by lack of material to recycle (24.7%), laziness (5.59%), lack of space (2.59%) and there is nobody at home (2.6%). Besides, 62.2% of the residents in Kampar, Perak were willing to practice waste separation and transfer the recyclable waste to the recycle center, mostly due to financial benefits and charity purposes (Bashir *et al*., 2018). On the other hand, Mohd Halim *et al*. (2018) demonstrated a positive response of 90.3% for Iskandar Malaysia residents who would segregate waste if recycling facilities such as recycle bins were provided. Shortly, this research obtained the same findings for item 1 with all the three research discussed.

Next, Musbah Swesi *et al*. (2019) proclaimed that there was a cumulative 77% of the respondents in Serdang, Selangor strongly agreed and agreed that they were willing to segregate their waste for recycling. The finding was similar to this study as the majority of Puchong suburban residents (70.5%) strongly agreed and agreed that they would practise waste separation in daily lives (item 1). In addition, a cumulative 61.2% of Serdang residents strongly agreed and agreed that they were

prepared to pay for solid waste services. Similarly, 58.9% of respondents strongly agreed and agreed that they were ready to pay for recycling activities (item 11) in this study. Summarily, the respondents were disclosed having a high willingness to participate in recycling activities.

Relationship between Awareness Level and Willingness to Participate in Recycling

To investigate the association between respondents' recycling awareness level and willingness to participate in recycling, non-parametric correlations such as Kendall's tau-b correlation and Spearman rank-order were computed. The results of both the analyses were demonstrated in Table 3 and Table 4, respectively.

Table 3: Kendall's tau-b correlation between awareness and willingness to participate in recycling

	Awareness	Willingness
Awareness	1.000	
Willingness	.451**	1.000

**. Correlation is significant at the 0.01 level (2-tailed).
Note: N = 424, p = 0.000

Based on the Table 3, Kendall's tau-b correlation between recycling awareness and willingness to participate was moderate, r = .451, n = 424, p = 0.000. According to the guidelines by Fowler, Cohen and Jarvis (2009), a correlation coefficient of 0.451 indicated a moderate strength association between the variables. Besides, a positive r value indicated a positive relationship between the two variables. In other words, when the respondents' recycling awareness increased, their willingness to participate in recycling increased correspondingly.

Furthermore, the two-sided test of significance, $p < 0.01$ was proved to be statistically highly significant. This indicated that there was strong evidence against the null hypothesis, as there was less than a 1% probability the null was correct. Therefore, the alternative hypothesis was accepted, showing that there was a significant association between the awareness level and willingness to participate in recycling.

Usually, Kendall's tau-b correlation coefficient is smaller in values than Spearman's rho correlation. It is more insensitive to error and the level of statistical significance, p-values are more accurate with smaller sample sizes. Despite the better statistical properties of Kendall's tau distribution, another correlation analysis, Spearman rank-order was conducted to increase the validity of results.

Table 4: Spearman rank-order correlation between awareness and willingness to participate in recycling

	Awareness	Willingness
Awareness	1.000	
Willingness	.600**	1.000

**. Correlation is significant at the 0.01 level (2-tailed).
Note: N = 424, p = 0.000

From the Table 4, Spearman rank correlation between the awareness level and willingness to participate in recycling was moderate, r = .600, n = 424, p = 0.000. Similar to Kendall's tau-b correlation, the r value from Spearman rank correlation fell under the category of moderate strength.

Without a negative sign for the r value, it implied that there was a positive relationship between the variables. For instance, if the recycling awareness decreased, the willingness to participate would follow to decrease. To avoid this, relevant actions shall be taken by both the authority and public.

Moreover, as the two-sided test of significance, $p < 0.01$, suggested that the results were statistically highly significant. It had strong enough evidence to reject the null hypothesis and accept the alternative hypothesis instead. By this, there was a significant relationship between awareness level and willingness to participate in recycling affirmed.

Generally, Spearman rank correlation coefficient has larger values than Kendall's tau-b. Unlike Kendall's tau-b, the calculations of Spearman rank correlation are based on deviations. Therefore, it is much more sensitive to error and discrepancies in data. To consider the advantages from both correlation analyses, two methods were carried out to enhance the reliability of results. In a nutshell, there was a positive moderate relationship between recycling awareness and willingness to participate.

Unlike the first two objectives, there was insufficient past literature regarding the association between recycling awareness and willingness to participate. Most of the previous studies emphasized on the relationship between knowledge, attitude and practice, but lacked findings that highlighted the direct effect of awareness (knowledge of expected outcomes) on willingness to participate (measured by intention). One study carried out by Gusti (2016) in Padang, Indonesia stressed on the relationship between knowledge and behavioral intention of sustainable waste management. The $t = 5.02$, $p = 0.000$ indicated that there was a relationship between recycling knowledge and intention. In brief, the results from this study were complementary with past research.

Conclusions

Environmental consciousness and awareness is a consequential aspect in recycling activities. When one grows awareness about environmental concerns, his or her intention to recycle will be positively influenced because they realize the beneficial outcomes of recycling. The public's perception on recycling behavior is critical, and hence this research aims to investigate the residents' recycling awareness and willingness to participate.

From the results obtained, the recycling awareness of residents in Puchong suburban residential areas was recorded at a high level. Among all the items, the majority of residents were most aware of the advantages of recycling, impacts from mismanagement of solid waste and understood that the solid waste generation was a significant global issue. While for the willingness to participate in recycling, most of the residents were reported to have a high willingness to engage in. For example, more than half of the residents were willing to use the recycling bins provided, to comply with existing legislations as well as to support proposals for new enactments regarding the solid waste recycling. Despite the optimistic results obtained, continuous efforts must be made to pursue an ideal prospect in a near future.

Apart from that, the association between the recycling awareness and willingness to participate was reported moderate in strength. This indicated that the awareness level was somewhat having an influence on the willingness to participate in recycling. The results were found in line with the theoretical assumptions theory of planned behavior. Also, it supported the findings that found a

general knowledge of the environment can significantly predict the behavior of recycling (Gusti, 2016).

However, there were several limitations on this study. Firstly, the time limit had been one of the challenges during the completion of this study. With the current situation of Covid-19, the standard operating procedures (SOPs) were applied, and this limited the time spent to collect data. Then, the 5-point Likert scale used in the questionnaire distributed might have caused central tendency bias. As this type of scale allows respondents to choose the neutral option, the analysis and interpretation of results becomes more challenging. To improve the research in the future, the use of a 4-, 6- or 8-point Likert scale may be more helpful. Furthermore, as this research only involved two variables: awareness and willingness, further research could additionally investigate other variables such as subject norm, moral norm and self-efficacy to contribute to the knowledge of related field.

To sum things up, the knowledge on sustainable waste management is positively associated with intentions of sustainable waste management. One's cognitive domain knowledge such as knowing from experience is very essential for the formation of their actions. Therefore, communication and education efforts to broaden the knowledge on issues regarding environmental concerns are imperative as they have been effective in bolstering behavior that is considered a good disposition for the natural environment.

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Declaration of Interest Statement

The authors declare that they have no conflicts of interests.

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