

ORIGINAL ARTICLE

Unveiling Youth's Perceptions and Behaviors Towards Plastic Usage and Management Amidst the COVID-19 Pandemic: A Knowledge, Attitudes, and Practices (KAP) Study

*Sharifah Norkhadijah Syed Ismail^{1,2}, Lee Yi Jia¹, Nor Eliani Ezani¹, Aida Soraya Shamsuddin³, Nurulain Mustafa Udin⁴, Jofirin Uding Rangga⁵

¹ Department of Environmental and Occupational Health, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, 43400 Serdang, Selangor.

² Malaysian Research Institute on Ageing (MyAgeing), Universiti Putra Malaysia, 43400 Serdang, Selangor.

³ Southeast Asia Disaster Prevention Research Initiative (SEADPRI), Institute for Environment and Development (LESTARI) LESTARI, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor
Faculty of Applied Sciences, University Teknologi MARA, 40450 Shah Alam, Selangor Darul Ehsan

⁵ Department of Health Sciences, Faculty of Humanities and Health Sciences, Curtin University Malaysia, CDT 250, 98009 Miri, Sarawak, Malaysia

ABSTRACT

Introduction: The Covid-19 pandemic, has led to a significant increase in plastic waste generation worldwide. This surge encompasses the disposal of plastic-based personal protective equipment (PPEs) and various single-use plastics (SUPs), intricate composition of plastic waste during this crisis has presented challenges in its effective management. **Objectives:** This study aimed to assess the level of knowledge, attitudes, and practices (KAP) regarding plastic usage and management among youths during the pandemic. **Methods:** A cross-sectional study was conducted among 344 youths in the Klang Valley using a self-administered questionnaire distributed through an online platform. **Results:** The primary sources of plastic waste were PPEs (77.3%), online shopping (68.9%), and food delivery packaging (68.9%). The majority of respondents disposed of PPEs and other SUPs together with mixed waste in the general dustbin, except for plastic bags, which were often reused by most participants. The study revealed that a higher percentage of respondents had a moderate level of knowledge (52%), a good level of attitude (61.3%), and fair practices (55.2%). The knowledge level was found to be associated with age groups and educational level, while attitude was associated with educational level. Furthermore, the study identified a significant association between attitude and practice, as well as between knowledge and attitude, with a p-value of <0.05. **Conclusion:** This study reveals that the youth have a moderate level of knowledge regarding plastic usage and management. It is noteworthy that this knowledge level significantly influences their attitude towards plastic waste and their practices related to its management.

Keywords: Knowledge; Attitude; Practice; Plastic; Covid-19

Corresponding Author:

Sharifah Norkhadijah Syed Ismail, PhD
Email: norkhadijah@upm.edu.my
Tel: +603-97692857

INTRODUCTION

The global health crisis caused by the coronavirus disease 2019 (COVID-19), specifically the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has disrupted lives worldwide and necessitated the adoption of new norms. In addition to measures like nationwide lockdowns, social distancing, and travel restrictions, the use of hand sanitizers and plastic-based personal protective equipment (PPEs)

became crucial in curbing the spread of the disease (1). Consequently, this crisis has shed light on the indispensable role of plastics in various sectors, including healthcare and public health safety. As a result, the plastic burden in Malaysia has escalated, with the country ranking second in annual per capita plastic usage at 16.78 kg per person, surpassing larger nations such as China, Indonesia, the Philippines, Vietnam, and Thailand (2).

Globally, the Covid-19 outbreak has led to a significant increase in the volume of plastic waste generated from personal protective gear, estimated at 1.6 million tonnes per day (3). This includes various items such as face masks, gloves, face shields, hand sanitizer

bottles, and medical gowns, predominantly composed of polymeric materials like polypropene (3, 4). During a one-month lockdown period in Bangladesh, the population disposed of an astonishing number of face masks, gloves, and hand sanitizer bottles, reaching 455 million pieces (53.07 tonnes/day), 1216 million pieces (101.3 tonnes/day), and 49 million pieces (300 tonnes/day) respectively (5).

Plastic is widely incorporated into numerous products, including grocery bags, containers, and bottles, owing to its synthetic organic polymer properties of affordability, durability, lightweightness, and strength (6). As the most commonly used material in our daily lives, it falls into the category of municipal solid waste, generated by households, commercial establishments, institutions, and industries. The Covid-19 pandemic, along with lifestyle changes, has further fueled the demand for plastic products, particularly in online food delivery, online shopping, and takeaway services, as people worldwide demonstrate increased purchasing power (7). These activities contribute to the accumulation of single-use plastics (SUPs) such as food containers, bottles, bubble wraps, packaging, and grocery bags. Filho et al., (8) reported a significant 53% surge in plastic packaging waste during the pandemic, as individuals spending more time at home altered their consumption behavior. Similarly, a study conducted in Singapore indicated a 73% increase in online food delivery and a 50% growth in online grocery shopping, with the highest frequency observed among respondents aged 29 and younger (9). In terms of waste generation, Adam (10) reported that Malaysian households produced over 200,000 tonnes of domestic waste monthly since the implementation of the first Movement Control Order (MCO) in March 2020, with plastic waste being a major contributor. Consequently, there has been an alarming increase in the disposal of single-use plastic food containers and packaging in landfills.

Consequently, managing plastic waste effectively has become challenging due to the complexities associated with its composition during the pandemic. While plastic offers convenience in our daily lives, the mismanagement of plastic waste can pose serious environmental and public health problems. In Malaysia, landfilling remains a common method for municipal solid waste disposal (6). However, challenges faced in current waste management systems, such as a lack of workers, limitation in the treatment facility, and mechanical recycling facility interruptions resulting from the pandemic, might lead to incorrect waste disposal and thereby damage the environment (11). With regard to recycling practices, Malaysia recorded a recycling rate of 31% in 2020, with the goal of reaching a recycling target of 40% by 2025 (12). However, this rate is relatively low compared to

other Asian countries such as South Korea (54%) and Singapore (34%) (13). Consequently, the current recycling rate is insufficient to keep up with the increasing volume of plastic waste generated in the country.

Given that youths play a crucial role in fostering environmental citizenship, it is essential to focus on their plastic consumption and management patterns, as well as their knowledge, attitudes, and practices (KAP) towards this issue. However, there is a limited amount of published data available that assesses the plastic consumption and management patterns of youths and their KAP levels specifically in Malaysia. Assessing the KAP levels related to plastic usage is crucial. This is because consumers who lack awareness and exhibit careless behavior and attitudes contribute to the mismanagement of waste, resulting in environmental damage caused by plastics (7). The issue becomes concerning as youths from different fields of study demonstrate notable differences in knowledge and behavior regarding plastic waste (14). Nordin's study (15) reported that the majority of the youth in the university had a high level of knowledge (85.2%), negative attitudes (57.1%), and poor practices (51%) towards recycling. Similarly, another study found disparities between university staff and students, with a lower proportion of students (27%) agreeing with their responsibility to recycle compared to 48% of staff. Furthermore, only 28% of all students felt guilty when disposing of recyclable materials into a general dustbin, compared to 49% of staff (16).

These previous studies have reported on KAP levels regarding plastics; however, they focused primarily on the pre-pandemic condition and did not extensively investigate the situation in Malaysia. Therefore, the purpose of this study was to assess the KAP levels regarding plastic usage and management among youths during the Covid-19 pandemic. Assessing plastic usage and management among youths during the Covid-19 pandemic would make a significant contribution, considering it is the major health crisis that Malaysians have recently faced. This study highlights the importance of future initiatives, whether in response to public health emergencies or not, striking a balance between public and environmental safety, as these aspects are closely intertwined. Additionally, it expedites the process of determining the target group, enabling the planning and implementation of more specific intervention measures to achieve a desirable reduction in plastic waste and promote proper management practices in the near future. Moreover, it provides baseline data to evaluate the success of future programs. By promoting the wise use and effective management of plastics, we can reduce the health and environmental impacts and ultimately improve the quality of life in all its forms.

MATERIALS AND METHODS

Study location and study design

This study employed a cross-sectional research design. The study was conducted in Klang Valley, a central region in Selangor state. This area experiences high urbanization rates and e-commerce activities, contributing to a significant increase in plastic waste generation. Furthermore, the presence of numerous educational institutions and job opportunities attracts a large population of youths, making it an ideal focus for this study.

Sample size calculation and sampling method

The sample size for this study was determined using the one-sample proportion formula by Charan & Biswas, (2013) as in Eq.1.

$$\text{Sample saiz (n)} = \frac{Z^2 1 - \alpha P(1-P)}{d^2} \quad \text{Eq.1}$$

Where α is 0.05 level of significance, $Z_{1-\alpha}$ is 1.96 of 95% confidence level, P is the prevalence of good practice on general plastic usage and disposal among professional course students at Annamalai University by Srinivasan et al., (2019) (0.276) and d is 5% or 0.05 of desired precision level. To accommodate potential non-responses, we augmented the sample size to 338 respondents, factoring in a conservative 10% non-response rate.

Youth aged 18-30 years old were selected for this study using convenience sampling. This sampling method was chosen because it allowed for easy accessibility and recruitment of subjects who were readily available. Social media platforms such as WhatsApp, Facebook, and Instagram were utilized to approach and recruit participants during the pandemic. Respondents were informed about the study's procedures and purpose prior to receiving the consent form and questionnaire. Participants who provided consent were requested to complete the questionnaire using a provided Google Form link.

Questionnaire

A self-administered questionnaire in English and Malay was used to assess knowledge, attitude, and practice regarding the usage and management of various types of plastics during the Covid-19 pandemic. Respondents were assured of the confidentiality of their personal information and responses throughout and after the study. The questionnaire, divided into three sections, drew comprehensive adaptations from previous studies. It consist of Section A; Socio demographic, Section B; Plastic usage and management during Covid-19 pandemic and Section C; Knowledge, Attitude and Practice. The questions used a close-response format with a predetermined list of options, requiring approximately 10 minutes to complete. The

questionnaire was adopted from several references (7, 14, 17 - 23)".

The questionnaire content was validated by an environmental health expert, and modifications were made to enhance question clarity and minimize bias in responses. A pre-test of the questionnaire was conducted on 10% of the sample size. Their feedback and comments were collected to make necessary improvements, including reducing the number of questions and correcting grammar. Following the pre-test, Cronbach's alpha analysis was performed. The Cronbach's alpha values were 0.712 for knowledge, 0.891 for attitude, and 0.768 for practice. These values indicate an acceptable level of internal consistency, as they between the range of 0.7 to 0.95.

Ethical approval (Ref: JKEUPM-2021-377) was obtained from the Ethical Committee for Research involving Human Subjects of University Putra Malaysia (JKEUPM) prior to data collection. All data collected were analyzed using IBM Statistical Package for Social Science (SPSS) version 25.0.

RESULTS

The response rate for this study exceeded 100% with a total of 344 online questionnaires received, surpassing the estimated sample size of 338 respondents. The mean age of respondents was 22.5 ± 2.7 years. The majority of respondents were aged between 21-23 years (54.1%), females (59.3%), and identified as Chinese (61.3%). Most were single (96.5%), held a Bachelor's degree (67.2%), and were students (75.6%). Other educational levels included Pre-university (21.5%), secondary education (5.5%), Master's degree (5.5%), and Doctoral degree (0.3%). Occupation-wise, the highest number of respondents were students (75.6%), followed by employees (18.6%), self-employed individuals (3.8%), and the unemployed (2%) (Table I).

Plastic usage and management during COVID-19 pandemic

The study identified the major sources of plastic waste that were predominantly discarded by the respondents during the pandemic. The majority of the plastic waste (77.3%) originated from personal protective equipment (PPE) such as facemasks, gloves, and hand sanitizer bottles. This was closely followed by online shopping platforms such as Lazada and Shopee (68.9%), as well as food delivery services including Food Panda and Grab food (68.9%). The majority of respondents disposed of 1-2 pieces of PPEs (gloves, face masks, face shields) per week ($n=105$, 30.5%). Similarly, 35.2% ($n=121$) disposed of 1-2 face shields per week, and 32.6% ($n=112$) disposed of 1-2 gloves per week. Over a span of 6 months, 49.1% ($n=169$)

Table 1 : Socio-Demographic Characteristics (N=344)

Socio-demographics characteristics	Mean (SD)	Frequency (n)	Percentage (%)
Age			
18-20	22.5 (2.7)	70	20.3
21-23		186	54.1
24-26		60	17.4
27-30		28	8.1
Gender			
Male		140	40.7
Female		204	59.3
Ethnicity			
Malay		122	35.5
Chinese		211	61.3
Indian		7	2
Others		4	1.2
Marital Status			
Single		332	96.5
Married		12	3.5
Highest Education level			
Secondary education		19	5.5
Pre-University		74	21.5
Bachelor's degree		231	67.2
Master's degree		19	5.5
Doctoral degree		1	0.3
Occupational Status			
Students		260	75.6
Employee		64	18.6
Self-employed		13	3.8
Unemployed		7	2.0

disposed of 1-2 hand sanitizer bottles. Single-use plastics, such as bubble wrap (n=132, 38.4%), plastic courier bags (n=129, 37.5%), plastic bottles (n=125, 36.3%), and plastic cutlery (n=118, 34.3%), were disposed of every week by the majority of respondents. Plastic bags (n=110, 32%) and plastic food containers (n=109, 31.7%) had a higher disposal frequency of 3-4 pieces per week.

Over half of the respondents disposed of face masks (n=217, 63%), face shields (n=121, 35.2%), gloves (n=127, 36.9%), and hand sanitizer bottles (n=164, 47.7%) mixed with domestic waste. A smaller percentage (between 12.5% to 14.5%) disposed of them in separate bags. Some respondents (between 4.1% to 12.2%) disposed of PPEs with recyclable

waste or plastic waste (3.5% to 9.6%) (Fig. 4). The majority of respondents threw their plastic waste into the dustbin, including bubble wrap (n=185, 53.8%), plastic courier bags (n=180, 52.3%), plastic cutlery (n=155, 45.1%), plastic food containers (n=146, 42.4%), and plastic bottles (n=127, 37%). Despite this, 49.1% (n=169) of respondents chose to reuse plastic bags, while 33.7% (n=116) disposed of them in the dustbin. Some respondents reused other single-use plastics such as plastic food containers (n=124, 36%), plastic bottles (n=71, 20.6%), and plastic courier bags (n=78, 22.7%). The least number of people (n=47, 13.7%) chose to reuse plastic cutlery. Regarding recycling, plastic bottles had the highest recycling rate (n=73, 21.2%) compared to other types of plastics.

Table II : The knowledge, attitude and practice score by socio-demographics factors (N = 344)

Variables	Score of Knowledge Mean (SD)	Z / χ^2 (p- value)	Score of attitude Mean (SD)	Z / χ^2 (p- value)	Score of practice Mean (SD)	Z / χ^2 (p- value)
Age^b						
18-20**	7.1 (1.9)	20.765	48.6 (7.5)	3.565	35.7 (7.2)	1.905
21-23**	7.9 (1.7)	(<0.001*)	50.7 (6.4)		36.9 (6.9)	(0.592)
24-26**	8.1 (1.6)		49.9 (6.8)	(0.312)	36.5 (7)	
27-30**	8.3 (2)		48.1 (10.2)		36.9 (9.1)	
Gender^a						
Male	7.8 (1.8)	0.361	49.5 (7.4)	-0.907	37.4 (6.9)	1.877
Female	7.8 (1.7)	(0.718)	50.3 (7)	(0.364)	36.1 (7.3)	(0.061)
Ethnicity^b						
Malay	7.8 (1.7)	0.816	50.9 (7.2)	6.762	36 (7.5)	3.094
Chinese	7.8 (1.8)	(0.846)	49.3 (7.1)	(0.08)	37 (6.7)	(0.377)
Indian	8.4 (0.8)		53 (7.2)		38.1 (9.4)	
Others	8 (0.8)		49.5 (4.4)		30 (10.9)	
Marital Status^a						
Single	7.8 (1.8)	-2.076	49.9 (7.2)	-0.998	36.6 (7.2)	-0.219
Married	8.6 (1.9)	(0.038*)	51.9 (6.5)	(0.318)	37 (6.8)	(0.827)
Highest Education^b						
Secondary education**	6.4 (2.5)	19.256 (0.001*)	43.3 (6.9)	20.605 (<0.001*)	33.9 (6.3)	7.465 (0.113)
Pre-University	7.5 (1.8)		49.6 (6.8)		37 (6.3)	
Bachelor's degree**	8 (1.6)		50.7 (6.9)		36.7 (7.3)	
Master's degree**	8 (2.4)		50.1 (6.8)		38.2 (7)	
Occupational Status^b						
Students	7.7 (1.8)	6.895	50 (7)	1.171	36.4 (7.1)	2.744
Employee	8.1 (1.8)	(0.075)	49.8 (7.2)	(0.760)	36.5 (7.3)	(0.433)
Self-employed	8.5 (1.6)		47.5 (10.3)		39.3 (6.2)	
Unemployed	8 (1.3)		52.1 (4.3)		38.9 (6.8)	

* Significant at p <0.05.

** Significant differences obtained by Post hoc test (p<0.05)
Secondary education - Pre-university, p=0.019
Secondary education - Bachelor's degree, p <0.001.a. Mann-Whitney U Test
b. Kruskal-Wallis Test

Approximately 35.3% (n=121) of respondents always practiced sustainable plastic waste management. A larger group of youths (n=142, 41.3%) were not accustomed to sustainable plastic waste management due to finding it troublesome and inconvenient (n=104, 30.2%) or time-consuming (n=46, 13.4%). Moreover, 7 (2%) respondents claimed they don't care about the environment. Some respondents cited other reasons for not implementing sustainable plastic waste management, such as a lack of nearby plastic waste management services and facilities,

lack of support from family members, and insufficient knowledge about proper plastic waste management.

The majority of youths (n=285, 82.8%) were aware of the plastic waste problem during the Covid-19 pandemic. Over half of the respondents (n=228, 66.3%) acknowledged an increase in their plastic usage trend, while 12.2% (n=42) reported a decrease or no significant change. Additionally, 32 respondents (9.3%) were unaware of their plastic usage trend.

Table III : Pearson’s Chi-square Test for the Association of KAP levels on Plastic Usage and Management

Variables		Practice			Test statistics		
		Poor n (%)	Moderate n (%)	Good n (%)	χ^2	df	p-value
Knowledge	Poor	9(32.1)	15(53.6)	4(14.3)	5.968	4	0.202
	Moderate (n=179)	47(26.3)	109(60.9)	23(12.8)			
	Good	43(31.4)	66(48.2)	28(20.4)			
Attitudes	Poor	7(53.8)	5(38.5)	1(7.7)	25.146	4	<0.001*
	Moderate	48(40)	64(53.3)	8(6.7)			
	Good (n=211)	44(20.9)	121(57.3)	46(21.8)			

Variables		Attitude			Test statistics		
		Poor n (%)	Moderate n (%)	Good n (%)	χ^2	df	p-value
Knowledge	Poor	5(17.9)	13(46.4)	10(35.7)	28.233	4	<0.001*
	Moderate (n=179)	5(2.8)	72(40.2)	102(57)			
	Good	3(2.2)	35(25.5)	99(72.3)			

Knowledge, attitude and practice

The study revealed varying levels of knowledge, attitudes, and practices among the respondents. As for knowledge, 52% (n=179) demonstrated a moderate level, 39.8% (n=137) showed good knowledge, and 8.1% (n=28) had poor knowledge. In terms of attitudes toward plastic usage and management, a majority of youths (61.3%, n=211) exhibited a positive attitude, while 34.9% (n=120) had a moderate attitude, and only 3.8% (n=13) displayed a poor attitude. As for their practices, 55.2% (n=190) of the youths had a moderate level of practice, 16% (n=55) demonstrated good practice levels, while 28.8% (n=99) exhibited poor practice levels.

The knowledge score significantly differed based on age ($\chi^2=20.765$, $p<0.001$), marital status ($z=-2.076$, $p=0.038$), and highest education level ($\chi^2=19.256$, $p=0.001$) (Table II). Post hoc analysis revealed that respondents aged 21 to 30 had significantly higher knowledge scores than those aged 18 to 20. Married individuals) exhibited higher knowledge scores compared to singles. Furthermore, respondents with a Bachelor’s and Master’s degree had higher knowledge scores compared to those with a secondary education. The attitude score significantly varied based on education level ($\chi^2=20.605$, $p<0.001$). Specifically, youths with pre-university education and Bachelor’s degree demonstrated significantly higher attitude

scores compared to those with secondary education. No significant differences were found between all sociodemographic factors and the score of practice on plastic usage and management among youths.

In this study, a significant association was found between age ($\chi^2=14.191$, $df=6$, $p=0.028$) and educational with the level of knowledge ($\chi^2=35.354$, $df=8$, $p<0.001$). However, no significant associations were observed between gender, ethnicity, marital status, and occupational status with the knowledge level. The education level of the respondents was the only factor significantly associated with the attitude level ($\chi^2=23.217$, $df=8$, $p<0.001$). A higher percentage of respondents with secondary education (63.2%) exhibited a moderate level of attitude towards plastic usage and management. On the other hand, a greater number of respondents from pre-university (56.8%), Bachelor’s degree (66.7%), and Master’s degree (52.6%) were reported to have good attitude levels. No significant association was found between the socio-demographic factors of youths and their level of practice on plastic usage and management in this study. No significant association was found between knowledge and practice regarding plastic usage and management ($\chi^2=5.968$, $df=4$, $p=0.202$). Among the 179 respondents with a moderate level of knowledge, the majority (n=109, 60.9%) also practiced moderately. A significant association was observed

between attitude and practice ($\chi^2=25.146$, $df=4$, $p<0.001$). Respondents with a good level of attitude ($n=211$) were found to practice moderately ($n=121$, 57.3%). Furthermore, a significant association was found between knowledge and attitude level of plastic usage and management ($\chi^2=28.233$, $df=4$, $p<0.001$). Among the 179 respondents with a moderate level of knowledge, most of them ($n=102$, 57%) had a good level of attitude (Table III).

DISCUSSION

The top sources of plastic waste generated by youths were personal protective equipment (PPE), online shopping, and food delivery. The Covid-19 pandemic has contributed to the surge in plastic-based PPEs and single-use plastics from takeaway services and e-commerce shopping (1). The containers and packaging category, compared to pre-Covid-19 times, significantly contributed to the overall plastic waste volume (14.5 million tons in 2018) (24). The increased use of plastic-based PPEs during the pandemic has raised concerns about their impact on human and environmental health.

Regarding PPE disposal frequency, facemasks, face shields, and gloves were disposed of 1-2 times per week, while hand sanitizer bottles were disposed of less frequently. The minimal frequency of PPE disposal among youths studying at home has been achieved. An estimated 130 billion face masks and 64 billion gloves were used globally each month during the pandemic (25). During the pandemic, a majority of respondents disposed of 1-2 pieces of single-use plastics weekly, with plastic food containers and bags being disposed of more frequently. The higher frequency of online shopping during the pandemic has led to increased plastic waste generation, and the emerging plastic threats amounting 148 thousand tonnes in Malaysia from food packaging alone have been reported. According to a recent survey on Covid-19, 57% of Malaysians have shown increased frequency in online shopping compared to the pre-pandemic period (26). It is estimated that globally, around 1.6 million tonnes of plastic waste are discarded daily as a result of Covid-19 (3).

Improper plastic waste management poses significant challenges to human and environmental health. In this study, used PPEs and other single-use plastics were commonly disposed of with general waste, eventually ending up in landfills. The disposal of masks and gloves in general dustbins after first use is a common practice observed in similar surveys. The findings align with a survey conducted by Mejjad et al., (27), which revealed that 70% of the Moroccan population disposed of their masks and gloves in general dustbins after their initial use. In 2018, the United States Environmental Protection Agency (USEPA) reported

that a staggering 27 million tons of plastic were deposited in landfills. Dumping plastic waste in landfills is considered the least preferred waste disposal option, as it may pose hazard to environment and human.

In this study, a significant majority of youths (49.1%) reported reusing plastic bags, a rate that is twice as high as the findings reported by Joseph et al., (22), where only 20% of participants expressed a preference for reusing plastic bags after initial usage. Plausible reasons cited for reusing plastic bags include their affordability, versatility, lightweight nature, and convenience for storage and transportation (20; 28). This practice alone is insufficient to support sustainable environmental practices, considering the reported cases of plastic bag pollution in rivers, oceans, and roadsides.

Improper disposal of plastic waste can result in the emission of CO₂ and methane gases during degradation, contributing to climate change (29). Disposable surgical face masks, in particular, have been found to contribute to 0.6 kg CO₂ emissions (30). The degradation process of plastics can also lead to the release of toxic additives, contaminating soil and water and posing risks to human health. Exposure to BPA, for example, has been associated with an increased probability of breast and prostate cancer (31).

In this study, slightly over half of the respondents (52%) demonstrated a moderate level of knowledge, while approximately 40% exhibited a good level of knowledge regarding plastic usage and management. These findings align with the results reported by Praveena (32), where 45% of respondents displayed a moderate level of knowledge about plastic health hazards, but none reached a good knowledge level. Similarly, Srinivasan et al. (28) conducted a study among 104 professional course students in India and obtained a similar result, with 46% of respondents showing a good knowledge level, which they considered relatively low compared to previous studies.

Although a majority of youths in this study possessed knowledge levels above moderate, a lower percentage of respondents demonstrated awareness on two specific items: only 50.3% and 57.3% knew that not all plastics used can be recycled or decomposed over time. These findings were lower compared to a study conducted among university students at Universiti Putra Malaysia Serdang, where 85.2% of them exhibited higher knowledge levels about recycling (15). Chaudhary et al., (33) also revealed that 88% of students were aware of the non-biodegradable nature of plastics, and this awareness increased to 94% after receiving plastic-related information during

a seminar. In Malaysia, commonly recycled plastics include Code 1: PET, Code 2: HDPE, and Code 5: PP (6). However, many types of plastics are not recycled due to economic viability issues and lower quality of the end product.

The higher knowledge levels among the majority of youths can be attributed to their higher literacy levels and the sources they use to acquire information, including formal resources, personal resources, social media, and mass media (34). In this study, social media emerged as the primary source for obtaining plastic-related information, emphasizing the importance of the internet among youths. Social media is widely utilized as a platform for disseminating news and information to the public worldwide. This can be attributed to the easy and increasing access to the internet, particularly among the tech-savvy generation of today. While most respondents demonstrated a moderate level of knowledge regarding plastic usage and management, many of them still acknowledged their continued reliance on plastic during the pandemic.

Furthermore, the favorable attitude level observed in this study aligns with the findings of studies conducted in Nelamangala and Wardha cities in India (21). Out of the 12 items assessed, 8 items received agreement from more than 70% of the respondents. Item 6, which emphasized the importance of proper plastic waste disposal, received the highest agreement at 90%. This finding is supported by Roche Cerasi et al., (35), where 95% of citizens strongly believed that proper plastic disposal methods, such as recycling, can transform waste into new products that serve as valuable resources for the community. Furthermore, 97% of respondents agreed that reducing and recycling plastics helps protect the environment from pollution. Additionally, approximately 88% of respondents agreed to reduce their use of single-use plastics in their daily lives. These findings are consistent with a study conducted in India, where almost all respondents demonstrated preparedness to reduce the usage of plastic bags (36).

The item measuring the willingness to participate in recycling programs in the future received agreement from only 68.3% of respondents. However, this percentage is twice as high as the household levels recorded in Malaysia, which stood at 35% (19). The lower agreement may be attributed to the respondents' limited understanding of the benefits associated with recycling. As Otitoju (37) highlighted, people are more likely to engage in recycling programs if they are aware of the benefits of recycling and waste management methods, and if they are involved in the program design stage.

Moreover, respondents showed slightly lower agreement regarding the willingness to pay more for items containing biodegradable plastics, the willingness to disseminate information about the plastic waste issue to friends and family members, and the willingness to seek more information about the effects of excessive plastic consumption. The lower agreement on the willingness to pay more for items with biodegradable plastics is because consumers often prioritize price and product quality over eco-friendly packaging. Additionally, the lower willingness to disseminate information to others may be attributed to the over-reliance on information obtained from the internet.

The findings of this study indicate that having a good attitude does not necessarily translate into better practices, as a higher percentage of youths demonstrated only a fair level of practice (55.2%). This is consistent with the study conducted by Ahamad & Ariffin (34), where most students (49.2%) exhibited an acceptable level of practice in sustainable consumption. Similarly, in Thailand, the majority of residents (59%) demonstrated a moderate level of practice in solid waste management (38). Barloa et al. (40) conducted a similar study among undergraduate students in the Philippines and reported that less than half (43.1%) of the students had a satisfactory level of practice in waste management, while 56.9% required further improvement. However, this study shows a positive result compared to the findings of Srinivasan et al., (28), where only 38.7% of students from various study courses demonstrated a moderate level of practice.

The items that were most frequently practiced were "bringing reusable bags when going shopping" and "reusing plastic bags after initial usage," with 41% and 49.1% of respondents always practicing these behaviors, respectively. These items contribute to sustainable consumption, as excessive plastic usage can lead to a larger plastic footprint. Furthermore, youths were asked to identify their reasons for not practicing sustainable plastic waste management. Many of them claimed that they were not accustomed to sustainable practices as they found them troublesome and time-consuming. Some respondents admitted that they simply do not care about the environment. The proportion of respondents citing "not being used to practicing it" was higher compared to the findings of Ahamad & Ariffin (34), where it was recorded at 28.3%. Additionally, some participants mentioned limited plastic waste management services and facilities, as well as a lack of support from family members, as hindrances to their practices. As reported by Nua (40), approximately

2-3 billion people worldwide lack access to waste collection and disposal services, leading to inconvenience for individuals who have to travel long distances to drop off their recyclable waste at facilities. Other reasons include insufficient knowledge about managing and handling plastic waste correctly. Individuals tend to avoid taking action when uncertainties arise due to their limited knowledge on the subject.

CONCLUSION

This study reveals that a higher percentage of youths have a moderate level of knowledge, a high level of attitude, and fair practice of plastic usage and management. The majority of respondents expressed awareness of the plastic waste issues during the Covid-19 pandemic. Additionally, most participants acknowledged that their plastic usage had increased during the pandemic compared to the period before. The top three sources of plastic waste identified in the study were personal protective equipment (PPE), online shopping, and food delivery.

In terms of waste management practices, the majority of youths tend to dispose of plastic waste in general dustbins, with the exception of plastic bags, which are more commonly reused. The findings highlight a significant association between attitude and practice, as well as between knowledge and attitude. This suggests that knowledge about plastics influences attitude, which, in turn, affects the translation into sustainable practices.

ACKNOWLEDGMENT

The authors would like to thank the respondents for their contribution and in this study.

REFERENCES

- Patricio Silva, A. L., Prata, J. C., Walker, T. R., Duarte, A. C., Ouyang, W., Barcelo, D., & Rocha-Santos, T. (2021). Increased plastic pollution due to COVID-19 pandemic: Challenges and recommendations. *Chemical Engineering Journal*, 405, 126683. <https://doi.org/10.1016/j.cej.2020.126683>
- WWF-Malaysia. (2020). WWF Releases Report Proposing Effective Solution to Mitigate Plastic Pollution in Malaysia | WWF Malaysia. <https://www.wwf.org.my/?28105/WWF-Releases-Report-Proposing-Effective-Solution-to-Mitigate-Plastic-Pollution-in-Malaysia>
- Benson, N. U., Basse, D. E., & Palanisami, T. (2021). COVID pollution: impact of COVID-19 pandemic on global plastic waste footprint. *Heliyon*, 7(2), e06343. <https://doi.org/10.1016/j.heliyon.2021.e06343>
- Fadare, O. O., & Okoffo, E. D. (2020). Covid-19 face masks: A potential source of microplastic fibers in the environment. *Science of the Total Environment*, 737, 140279. <https://doi.org/10.1016/j.scitotenv.2020.140279>
- Haque, M. S., Uddin, S., Sayem, S. M., & Mohib, K. M. (2021). Coronavirus disease 2019 (COVID-19) induced waste scenario: A short overview. *Journal of Environmental Chemical Engineering*
- Chen, H. L., Nath, T. K., Chong, S., Foo, V., Gibbins, C., & Lechner, A. M. (2021). The plastic waste problem in Malaysia: management, recycling and disposal of local and global plastic waste. In *SN Applied Sciences* (Vol. 3, Issue 4, p. 437). Springer Nature. <https://doi.org/10.1007/s42452-021-04234-y>
- Parashar, N., & Hait, S. (2021). Plastics in the time of COVID-19 pandemic: Protector or polluter? *Science of the Total Environment*, 759, 144274. <https://doi.org/10.1016/j.scitotenv.2020.144274>
- Filho, W. L., Voronova, V., Kloga, M., Pazo, A., Minhas, A., Salvia, A. L., Ferreira, C. D., & Sivapalan, S. (2021). COVID-19 and waste production in households: A trend analysis. *Science of the Total Environment*, 777, 145997. <https://doi.org/10.1016/j.scitotenv.2021.145997>
- Elangovan, N. (2020). Singapore households generated additional 1,334 tonnes of plastic waste during circuit breaker: Study . TODAY. <https://www.todayonline.com/singapore/singapore-households-generated-additional-1334-tonnes-plastic-waste-during-circuit-breaker>
- Adam, A. (2021). SWCorp data shows trashpile averaged slightly over 200,000 tonnes a month since MCO 1.0, mostly from food and plastics | Malaysia | Malay Mail. <https://www.malaymail.com/news/malaysia/2021/03/11/swcorp-data-shows-trashpile-averaged-slightly-over-200000-tonnes-a-month-si/1956803>
- Bureau of International Recycling (BIR). (2019). Covid-19 Update: Fragmented picture for under-pressure recycling industry. <https://www.bir.org/news-press/covid-19-info-center/item/covid-19-update-fragmented-picture-for-under-pressure-recycling-industry>
- Nur Hanani, A. (2020). KPKT: Six WTE plants planned towards 2025. *The Malaysian Reserve*. <https://themalaysianreserve.com/2020/06/22/kpkt-six-wte-plants-planned-towards-2025/>
- Department of Statistics Malaysia. (2020). Compendium of Environment Statistics, Malaysia 2020. <https://www.dosm.gov.my/v1/index.php?r=column/pdfPrev&id=TjM1ZlFxb3VOakdmMnozVms5dUIKZz09>
- Situmorang, R. O. P., Liang, T.-C., & Chang, S.-C. (2020). The Difference of Knowledge and Behavior of College Students on Plastic Waste Problems. *Sustainability*, 12(19), 7851. <https://doi.org/10.3390/su12197851>

15. Nordin, S. (2016). Knowledge, attitude, and practices of recycling and its associated factors among undergraduate students in Universities Putra Malaysia, Serdang. *International Journal of Public Health and Clinical Sciences*, 3(6), 154–170.
16. Kelly, T. C., Mason, I. G., Leiss, M. W., & Ganesh, S. (2006). University community responses to on-campus resource recycling. *Resources, Conservation and Recycling*, 47(1), 42–55. <https://doi.org/10.1016/j.resconrec.2005.10.002>
17. Tan, T., & Siti Najihah, C. S. (2020). Public Survey: The Impacts of Movement Control Order (MCO) Towards Waste Generation in Penang Island. <https://www.who.int/malaysia/emergencies/coronavirus-disease->
18. Nowakowski, P., Kuśnierz, S., Sosna, P., Mauer, J., & Maj, D. (2020). Disposal of personal protective equipment during the covid-19 pandemic is a challenge for waste collection companies and society: A case study in poland. *Resources*, 9(10), 1–11. <https://doi.org/10.3390/resources9100116>
19. Afroz, R., Rahman, A., Masud, M. M., & Akhtar, R. (2017). The knowledge, awareness, attitude and motivational analysis of plastic waste and household perspective in Malaysia. *Environmental Science and Pollution Research*, 24(3), 2304–2315. <https://doi.org/10.1007/s11356-016-7942-0>
20. Hammami, M. B. A., Mohammed, E. Q., Hashem, A. M., Al-Khafaji, M. A., Alqahtani, F., Alzaabi, S., & Dash, N. (2017). Survey on awareness and attitudes of secondary school students regarding plastic pollution: implications for environmental education and public health in Sharjah city, UAE. *Environmental Science and Pollution Research*, 24(25), 20626–20633. <https://doi.org/10.1007/s11356-017-9625-x>
21. Khanam, N., Wagh, V., Gaidhane, A. M., & Quazi, S. Z. (2019). Knowledge, Attitude and Practice on Uses of Plastic Products, Their Disposal and Environmental Pollution: A Study among School-going Adolescents. *Journal of Datta Meghe Institute of Medical Sciences University*, 14(2), 57–60. https://doi.org/10.4103/jdmimsu.jdmimsu_27_19
22. Joseph, N., Kumar, A., Majgi, S. M., Kumar, G. S., & Prahalad, R. B. Y. (2016). Usage of plastic bags and health hazards: A study to assess awareness level and perception about legislation among a small population of Mangalore city. *Journal of Clinical and Diagnostic Research*, 10(4), LM01–LM04. <https://doi.org/10.7860/JCDR/2016/16245.7529>
23. Ѓьндođdu, S., Yeşilyurt, İ. N., Erbaş, C., & Ѓьтъъ, H. (2018). Survey on awareness and attitudes of citizens regarding plastic pollution in Hatay / Samandağ Turkey. *International Marine& Freshwater Sciences Symposium*, 134–138. <https://www.researchgate.net/publication/328601209>
24. US EPA. (2021). *Plastics: Material-Specific Data*. <https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/plastics-material-specific-data>
25. Prata, J. C., Silva, A. L. P., Walker, T. R., Duarte, A. C., & Rocha-Santos, T. (2020). COVID-19 Pandemic Repercussions on the Use and Management of Plastics. *Environmental Science and Technology*, 54(13), 7760–7765. <https://doi.org/10.1021/acs.est.0c02178>
26. Bernama. (2019, October 26). Plastic bag charge to be extended to all business premises in 2022. *New Straits Times*. <https://www.nst.com.my/news/nation/2019/10/533470/plastic-bag-charge-be-extended-all-business-premises-2022>
27. Mejjad N, Cherif EK, Rodero A, Krawczyk DA, El Kharraz J, Moumen A, Laqbaqbi M, Fekri A. Disposal Behavior of Used Masks during the COVID-19 Pandemic in the Moroccan Community: Potential Environmental Impact. *Int J Environ Res Public Health*. 2021 Apr 20;18(8):4382. doi: 10.3390/ijerph18084382. PMID: 33924217; PMCID: PMC8074620.
28. Srinivasan, N., Swarnapriya, V., Felix, A. J. W., & Pravin, T. (2019). Assessment of knowledge and practice on plastics among the professional course students of Annamalai University, Tamil Nadu. *International Journal Of Community Medicine And Public Health*, 6(2), 510. <https://doi.org/10.18203/2394-6040.ijcmph20190099>
29. Chandegara, V. K., Cholera, S. P., Nandasana, J. N., Kumpavat, M. T., & Patel, K. C. (2015). Plastic Packaging Waste Impact on Climate Change and its Mitigation. *Water Management and Climate Smart Agriculture. Adaptation of Climatic Resilient Water Management and Agriculture*. Gyan Publishing House, 404–415.
30. Lee, A. W. L., Neo, E. R. K., Khoo, Z.-Y., Yeo, Z., Tan, Y. S., Chng, S., Yan, W., Lok, B. K., & Low, J. S. C. (2021). Life cycle assessment of single-use surgical and embedded filtration layer (EFL) reusable face mask. *Resources, Conservation and Recycling*, 170(September 2020), 105580. <https://doi.org/10.1016/j.resconrec.2021.105580>
31. Seachrist, D. D., Bonk, K. W., Ho, S. M., Prins, G. S., Soto, A. M., & Keri, R. A. (2016). A review of the carcinogenic potential of bisphenol A. *Reproductive Toxicology*, 59, 167–182. <https://doi.org/10.1016/j.reprotox.2015.09.006>
32. Praveena , B. G. (2019). A Study to Assess the Knowledge Regarding Health Hazards of Plastic in Domestic Use and Attitude toward the use of Alternatives in Women Residing at Mohan Kumar Nagar, Bengaluru. *International Journal of Nursing and Medical Investigation*, 4(3), 50–53. <https://doi.org/10.31690/ijnmi/50>
33. Chaudhary, V., Kathuria, K., Tomar, M., & Jain, M. (2020). Study to Assess the Knowledge, Attitude and Practice of Plastic Use among School students of Meerut, Uttar Pradesh. *Indian Journal of Public*

- Health Research & Development, 62–68. <https://doi.org/10.37506/ijphrd.v11i11.11348>
34. Ahamad, N. R., & Ariffin, M. (2018). Assessment of knowledge, attitude and practice towards sustainable consumption among university students in Selangor, Malaysia. *Sustainable Production and Consumption*, 16, 88–98. <https://doi.org/10.1016/j.spc.2018.06.006>
 35. Roche Cerasi, I., S6nchez, F. V., Gallardo, I., Gyrriz, M., Torrijos, P., Aliaga, C., & Franco, J. (2021). Household plastic waste habits and attitudes: A pilot study in the city of Valencia. *Waste Management and Research*. <https://doi.org/10.1177/0734242X21996415>
 36. Babu, D., & James, R. (2016). Survey on Plastic Usage among the Teenagers of Alappuzha Town, Kerala. *Scholars Academic Journal of Biosciences*, 4(6). <https://doi.org/10.21276/sajb.2016.4.6.7>
 37. Otitoju, T. A. (2014). Individual Attitude toward Recycling of Municipal Solid Waste in Lagos, Nigeria. *American Journal of Engineering Research*, 3(7), 78– 88. www.ajer.org
 38. Laor P, Suma Y, Keawdoungek V, Hongtong A, Apidechkul T, Pasukphun N. Knowledge, attitude and practice of municipal solid waste management among highland residents in northern Thailand. *J Health Res*. 2018; 32(2).
 39. Barloa, E.P., Lapie, L.P., and Cruz, C. P. P. (2016). Knowledge, Attitudes, and Practices on Solid Waste Management among Undergraduate Students in a Philippine State University. *Journal of Environment and Earth Science*. Vol.6 (6).
 40. Nua. (2020, April 9). How to Continue Waste Management Services During the COVID-19 Pandemic – NUA Campus. UN Habitat. <https://nuacampus.org/how-to-continue-waste-management-services-during-the-covid-19-pandemic/>