A Study on The Fruits and Vegetables Consumption Patterns among Adults in Malaysia

Siti Hasma Hajar Binti Mat Zin, Suhanah Binti Rosnan, C T Munnirah Niesha Binti Mohd Shafee

A Study on The Fruits and Vegetables Consumption Patterns among Adults in Malaysia

Siti Hasma Hajar Binti Mat Zin, Suhanah Binti Rosnan, C T Munnirah Niesha Binti Mohd Shafee

Faculty of Computer and Mathematical Sciences, Universiti Teknologi Mara, Cawangan Johor, Kampus Segamat, 85000 Segamat, Johor, Malaysia
Email: hasmahajar@uitm.edu.my, suhan009@uitm.edu.my, ctmun518@uitm.edu.my

Abstract
Fruits and vegetables are important components of a healthy diet and human health. The presence of many vitamins and other substances in fruits and vegetables provides nutrients to the body. However, many people are not concerned about the importance of fruits and vegetables consumption in their daily lives. On that note, a study on the fruits and vegetables consumption among adults in Malaysia was conducted. This study can be very useful in providing more details about the consumption patterns of fruits and vegetables among respondents according to demographic characteristics and also in gaining new knowledge about the intake of fruits and vegetables in our lives. This survey is a cross-sectional study where data was collected through primary data by distributing the questionnaires using Google Form. A total of 291 adults participated in this study. The findings indicated that vegetables like garlic and onions are highly consumed daily. Meanwhile, fruit intakes such as oranges, watermelon, bananas and guava were highly consumed by most respondents. This study also identified that there is a significant association in the frequency of fruits consumption between race and age categories. On the other hand, there is a significant association between the frequency of vegetables consumption and gender. Malaysian adults consume a variety of fruits and vegetables. However, less than 50% of the respondents eat vegetables every day, and around 32% of them prefer to eat fruits 1 to 3 times per week. Many respondents did not know that fruits and vegetables contained lots of nutrients. Half of them did not know the daily recommended servings of fruits and vegetables. Therefore, there is a need to educate respondents about the nutrient content and the importance of increasing their consumption of fruits and vegetables and encourage Malaysians to eat five or more servings of fruits and vegetables every day in the context of a low-fat and high-fiber diet. It suggested that for future research, another study will be conducted to gain more information on attitudes and knowledge on fruits and vegetables consumption patterns among Malaysian adults as well as to improve what has been left in the current research.
Keywords: Fruits, Vegetables, Consumption, Adults, Malaysia

Introduction
Background of Study
Fruits and vegetables are important foods since they are low in fat, sodium, and calories compared to many other foods and also provide key nutrients such as vitamins, minerals, proteins and a good amount of dietary fibre for the human body (Izzah et al., 2012; Othman et al., 2013). Generally, the consumption of fruits and vegetables is a sign of a healthy overall diet. In particular, total fruit intake, including both total fruit and whole fruit consumption, ranks second and third in terms of their correlation with a general healthy eating pattern, respectively, after the number of empty calories consumed (Olatona et al., 2018).

According to Gavin (2009), different vegetables contain different nutrients. The vegetable group is divided into five subgroups based on their nutrients, including dark green, orange, dry beans and peas, starchy, and other vegetables. For example, green vegetables usually contain vitamin A, while dark orange and dark green vegetables contain vitamin C. Vegetables like broccoli and related plants have iron and calcium. Vegetables are very low in fat and calories, but cooking can often add these. For best nutritional value, serve a variety of vegetables each week. Meanwhile, fruits are the sweet-tasting seed-bearing parts of plants, or occasionally sweet parts of plants that do not bear seeds. Fruits are low in calories and fat. They have important nutrients like vitamin C, potassium, and fiber. Fruit juice retains the vitamins and minerals, but it will lose the fiber. Sometimes, the fruit food group is combined with the vegetable food group. Fruit should be consumed in 2 to 4 servings per day (Gavin, 2009).

Previous research has linked a lack of fruits and vegetables to an increased risk of certain cancers, including lung, esophageal, mouth, stomach, colon, and pancreatic cancer, as well as hypertension, cardiovascular disease, diabetes, stroke, obesity, diverticulosis, cataract, and high all-cause mortality (Wang et al., 2014; Choi et al., 2015; Aune et al, 2017). A report by the World Health Organization (WHO) recommended eating at least 400g or five portions of fruits and vegetables per day, excluding potatoes, sweet potatoes, cassava and other starchy roots. This is because it can help to decrease the risk of noncommunicable diseases (NCDs) and ensure an adequate daily intake of dietary fiber. In general, it is estimated that up to 2.7 million lives could potentially be saved each year if fruit and vegetable consumption were sufficiently increased. This is also supported by a study (El Bcheraoui et al., 2013). The risk of cardiovascular disease morbidity and mortality can be reduced by increasing the fruits and vegetables consumption. McGuire (2011) recommended improving the diet and increasing fruit and vegetable consumption. A fruit and vegetable diet plan can increase metabolism and add to nutritional health. Dieters should eat four to five servings of vegetables and two to three servings of fruit daily. While this diet is safe to follow for a long time, extreme dieting is never advisable.

As a result, it is critical to conduct a study that examines fruits and vegetables consumption patterns among Malaysian adults in order to determine how many people are concerned about the importance of fruit and vegetable intakes to their health. At the same time, this study can also give significant findings to those who were involved.

Problem Statement

Fruits and vegetables consumption among adults seems to be different in Malaysia and other countries around the world. Although there are many articles that explain the importance of fruits and vegetables consumption, only a few people are concerned about the importance of it to their health.

Fruits and vegetables are important components of a healthy diet, and their sufficient daily consumption could help prevent major diseases such as cardiovascular diseases (CVDs) and certain cancers. According to the World Health Report 2022, noncommunicable diseases (NCDs), including cardiovascular diseases (such as heart attacks and strokes), cancers, chronic respiratory diseases (such as chronic obstructive pulmonary disease and asthma) and diabetes, account for more than three quarters of global NCD deaths which is 31.4 million. Low fruits and vegetables consumption is associated with a higher risk of dying from cancer and vascular disease (Duthie et al., 2018; Lock et al., 2005). Then, from this study, it is important to examine and understand the food consumption pattern in order to promote fruits and vegetables selections among adults in Malaysia.

Overall, different countries show different intakes of fruits and vegetables. Malaysia's consumption of fruits and vegetables is still quite low when compared to other nations. Therefore, this study was conducted to determine the consumption pattern of fruits and vegetables among adults in Malaysia. This study also investigated the factors that contribute to the consumption pattern, such as age, gender, race and medical history.

Research Questions
1.   What are consumption patterns of respondents who consumed fruits and vegetables in Malaysia?
2.   Is there a significant association in the frequency of fruits consumption between race, gender and age categories?
3.   Is there a significant association in the frequency of vegetables consumption between race, gender and age categories?

Research Objectives
1.   To identify the consumption patterns of respondents who consumed fruits and vegetables in Malaysia.
2.   To determine the association in the frequency of fruits consumption between race, gender and age categories.
3.   To determine the association in the frequency of vegetables consumption between race, gender and age categories.

Literature Review
Classification of Fruits and Vegetables
Fruits and vegetables are important components of a healthy diet and human health. They are excellent sources of complex carbohydrates, dietary fiber, and several vitamins and minerals. There are many varieties of fruits and vegetables available. According to Pennington and Fisher (2009), classifications of fruits and vegetables are most helpful for dietary assessment and guidance and play a significant part in the nutritional supplement intake of humans. This is because fruits and vegetables are primary sources that contain some essential

nutrients and phytochemicals that may reduce the risk of chronic disease. In order to maintain the proper health of the body, it is a must to estimate the right nutrient intake by increasing the consumption of fruits and vegetables (Ragini et al., 2020). Generally, the variety of fruits and vegetables, such as irregular intraclass shape, colour and texture, and similar interclass shape, makes them difficult to classify (Hameed et al., 2018).

Many countries have food guides with graphic depictions of the food groups and subgroups along with recommendations for consumption. It can help people select appropriate types of foods to meet their nutrient and health needs. Based on Malaysian Dietary Guidelines 2020, the food groups consist of four levels that represent the five food groups of the Malaysian Food Pyramid. They are vegetables and fruits; rice, other cereals, whole grain cereal-based products and tubers; fish, poultry, eggs, meat, and legumes; and another one, milk and milk products. This food pyramid shows that fruits and vegetables represent the greatest number of servings that should be consumed as compared to other food groups.

Basically, different countries use various methods of classifying fruits and vegetables. Based on Slavin and Lloyd (2012), orange fruits and vegetables are given their own category since they are frequently rich in carotenoids. However, a lot of dark green veggies, like spinach, also contain a lot of carotenoids. While categorising fruit and vegetables by colour makes sense for meal planning, but it is not suitable for nutrient content. Some fruits and vegetables like citrus fruits, strawberries, green peppers, and white potatoes are excellent sources of vitamin C. However, these sources are dispersed across a wide range of fruit and vegetable categories. Aside from that, fruits and vegetables consist of phytonutrients (phytochemicals). These include polyphenols, anthocyanins, flavonoids, and carotenoids, which serve as the primary factors in providing immune-boosting effects after consumption (Slavin and Lloyd, 2012; Harasym and Oledzki, 2014). Leitzmann (2016) stated that phytonutrients help give their own colour to fruits and vegetables, while smell and taste act as antioxidants against oxidative stress.

According to Lampe (1999), fruits and vegetables come in a wide variety of colours and shades. The colours reflect the pigments present in the tissues, and some food components are known to be pigmented. For example, beta-carotene is deep orange, and anthocyanidin is red. The colour reflects the primary edible portion of each fruit and vegetable. The classification of fruits and vegetables is very important since it can give benefits to several fields, such as agriculture, industrial inspection, automated fruit segregation systems, and nutrition prediction (Ragini et al., 2020). Many studies have been conducted by proposing several systems in order to classify fruits and vegetables into groups (Ragini et al., 2020; Hameed et al., 2018; Bhargava and Bansal, 2021; Dubey and Jalal, 2015).

Barriers to Fruits and Vegetables Consumption
Barriers to the consumption of fruits and vegetables are the largest component of the variability in actual fruit and vegetable consumption. There are many barriers that cause some people to not like to eat fruits and vegetables, for example, low-income families, nutrition education, taste, consumer attitudes, costs, food preparation, lifestyles, and demography. For these reasons, it is often difficult for people to consume the recommended five or more servings of fruits and vegetables per day.

One major reason for lower fruit and vegetable consumption among low-income consumers is food prices. A study was conducted by Haynes-Maslow et al. (2013) among low-income communities. This study showed that there are few stores that sell fresh fruit and vegetables in low-income neighborhoods, and often these stores sell foods low in nutritional value. Due to a perceived lack of demand, grocery stores and farmers' markets seldom open in low-income areas, and if they do, the quality of fruits and vegetables that they sell is low compared to higher-income areas (Blitstein et al., 2012). This is also supported by Andreyeva et al. (2008). Fresh fruits and vegetables were of higher quality in higher-income neighbourhoods than in lower-income neighbourhoods. Low-income families consumed fewer fruits and vegetables compared to high-income families (Cassady et al., 2007). On the other hand, the price or cost, which is too expensive, is also a barrier to access to fruits and vegetables. According to one study, adults in Saudi Arabia consume fewer fruits and vegetables because they are too expensive (El Bcheraoui et al., 2013). Decreasing cost of fruits and vegetables might lead to higher consumption and a decline in chronic disease (Haynes-Maslow et al., 2013). This study suggests that the price of fruits and vegetables can be reduced by either providing subsidies or vouchers to low-income communities.

In addition, education level is one factor in lower fruit and vegetable consumption among adults. According to Hong et al (2012), individuals, including both men and women, in the low-education group showed a lower intake of fruit. Meanwhile, the consumption of vegetables is less consumed by women from this group. This study also proved that adults in the low education group did not like to eat carotene-rich fruits and vegetables, red fruit or vegetables, and dark-green leafy vegetables. They also ate fewer total vegetable dishes and fewer types of fruit compared to others. People in low education categories performed significantly worse than those in the highest education categories in comparing scores on factors affecting the consumption of fruits and vegetables. Individuals with a higher level of education were more concerned about nutrition than those with a lower level of education (Dittus et al., 1995).

Time issues are another frequently identified barrier to fruits and vegetables consumption. The effort of preparation and lack of preparation time may be seen as more of an issue for vegetables than fruit. This is agreed by Mook et al (2016), who stated that fruit and vegetable consumption has been influenced by perceived time constraints. Among food-secure respondents, preparation time was significantly associated with fruit and vegetable consumption. These findings are in line with the findings of other research that found associations between preparation time and daily consumption of fruits and vegetables (Williams et al., 2012; Kirkpatrick et al., 2012; Schatzer et al., 2010). In a survey that was conducted in Australia, they identified that there are three main barriers to vegetables, which are adequacy of intake, the time and the effort needed for vegetable preparation (Pollard et al., 2009). Alternatively, some people identify taste as a barrier to healthy eating. Taste is also a predictor of consumption of fruits and vegetables (Glasson et al., 2011; Mook et al., 2016; Alkazemi and Salmean, 2021). Taste and preference may also be associated with meal patterns that may vary across cultures and individuals. For example, some vegetables are consumed only at an evening meal, and this perceived restriction of eating occasions accordingly limits perceived available opportunities to increase consumption (Yeh et al., 2010).

Past Studies of Fruits and Vegetables Consumption Pattern
Many studies have conducted a survey to investigate patterns of fruits and vegetables consumption among adults. A survey was conducted in Malaysia by (Othman et al., 2013). It showed that Malaysian adults consumed a variety of fruits and vegetables. The results indicated that imported fruits such as apples and oranges were the most preferred and spices like chilies were the most frequently consumed by adults. They preferred to eat fruits and vegetables that had both quality and nutritional content. Another study conducted in Saudi Arabia proved that many of them did not consume many fruits and vegetables except for dates. This is because of pricing, which they said the fruits and vegetables are relatively expensive. Due to that reason, there is a reduction in fruit and vegetable intake among adults in that country (El Bcheraoui et al., 2013).

In the study by Perera & Madhujith (2012), it was observed that the majority of the students were unaware of the health benefits of the intake of fruits and vegetables. The average daily intake of fruits and vegetables was 267 g, which is much less than the amount advised for the particular age group. It also indicated that fruits such as bananas, papaya, mango, orange, and pineapple and vegetables like beans, dhal, carrot, potato, leeks, pumpkin, Gotukola and Mukunuwenna were the most frequently consumed by the respondents. A survey conducted by Lo et al (2022) also proved the same thing, where the result is discouraging since the majority of the respondents have less knowledge about the consumption of vegetables and fruits per day as recommended by the WHO. This study found that the average amount of fruits and vegetables consumed daily by Malaysian adults in this study was less than one serving compared to the recommended intake of five servings.

Several factors are associated with fruits and vegetables consumption behaviour among adults. Attitude, habit, social influences, and availability were found to have a significant effect on fruits and vegetables consumption behaviour. According to the study's findings, the environmental factor had a greater impact on adults' intentions to eat both fruits and vegetables compared to the personal factor (Othman et al., 2012). According to Olatona et al. (2018), adequate intake of fruits and vegetables was connected with educational status, income, female gender, and marriage. Aside from that, another study showed that gender, income, and taboos affect the quantity of fruits and vegetables consumed, but that academic year and ethnicity did not have a significant relationship with respect to the intake of fruits and vegetables (Perera & Madhujith, 2012).

Methodology
This is a cross-sectional study where data was gathered once over a period of four weeks. The study was conducted in Malaysia where the sample was drawn from the population, which comprised of adults were respondents chosen at random to participate in the study and 291 gave their cooperation by completing the questionnaire. The method used is a survey, where an online questionnaire was used to gain information from the respondents. A questionnaire was given to the respondents by using Google Form. The respondents were requested to answer all questions to minimize non-response errors. The respondents were informed of the confidentiality of the survey and that it was for academic purposes only.

The questionnaire was developed to study the consumption patterns of fruits and vegetables among adults in Malaysia. The questionnaire was developed based on some references

relating to previous studies on fruits and vegetables consumption. It consists of three sections. The first section examines the characteristics of the respondents. It was designed to collect socio-demographic information pertaining to age, gender, race, and education level. The second section provides a report on the medical history. It consists of smoking status and disease status such as diabetes, hypertension, heart disease, high cholesterol, constipation, dry skin, and obesity. Then, the final section discusses the analysis of the research questions. It is about fruits and vegetables consumption. It consisted of 52 questions. This section is a general question related to fruits and vegetables consumption patterns.

In this study, several types of analysis were used. These include descriptive analysis. It is used to describe the profile and characteristics of the respondents through frequency or percentage tables, cross tabulations, and charts such as pie charts and bar charts. Then, the Chi-Square Test of Independence is used to investigate whether distributions of categorical variables differ from one another. Cronbach's coefficient alpha is also used as a test of interitem consistency and reliability in the study. The Cronbach's alpha can be interpreted as a correlation coefficient; it ranges in value from 0 to 1. The higher the value of the Cronbach's alpha, the more reliable the measurement instrument (Sekaran, 2005). The measure of internal consistency of the measured items for each construct must exceed a minimum value of 0.6. A pilot study was conducted, and a total of 40 respondents were chosen at random. The results of the analysis showed that the items for the final section had a Cronbach's alpha reliability coefficient of 0.897. These results proved that the instruments were reliable.

Results and Discussion
Demographic Profile of The Respondents
This section examines the characteristics of the respondents, which comprise age, gender, race, education level, smoking status, and disease status among respondents.

Age group

The respondents consist of mainly adults who are in the age group of 18 until 73 years old. The mean (standard deviation) age of all respondents was 38.05 (14.4%) years and median (IQR) 38.00 (25 %). From Figure 1, a high percentage of the respondents were from the age group of 30-49 years old (38.1%). This followed by less than 30 years old (37.5%) and 50 and above (24.4%).

Figure 1: Percentage of the respondents by age group

Gender

Figure 2 shows that majority of the respondents (57%) in this study were female, while 43% were male respondents.

	Figure 2: Percentage of the respondents by gender
Race Based on Figure 3, more than half of the respondents were Malay (87%), while only 13% were non-Malay.	 Figure 3: Percentage of the respondents
Education Level Figure 4 shows majority of the respondents (92%) were highly educated.	 Figure 4: Percentage of the respondents by education level
Smoking Status Figure 5 shows that majority of the respondents (77%) had never smoked while 23% of the respondents have smoked.	 Figure 5: Percentage of the respondents by smoking status

Diseases Status

Relating to diseases status, a slightly majority of the respondents (24.1%) had obesity. This is followed by 15.8% with hypertension. The percentage of those with dry skin and constipation are comparable. Only a small percentage had a heart disease. All these are shown in Table 1.

Table 1
Diseases status of the respondents

Diseases Status	Frequency (%)
Obesity	**70 (24.1)**
Hypertension	46 (15.8)
Dry skin	43 (14.8)
Constipation	40 (13.7)
High cholesterol	34 (11.7)
Diabetes	22 (7.6)
Heart disease	10 (3.4)

Consumption Patterns of Fruits and Vegetables among Adults in Malaysia
Comparison between frequencies of fruits and vegetables consumption among adults
Figure 6 shows that about 45.4% (132) of the respondents are likely to eat vegetables everyday while 32% (93) prefer to eat fruits 1 to 3 times per week.
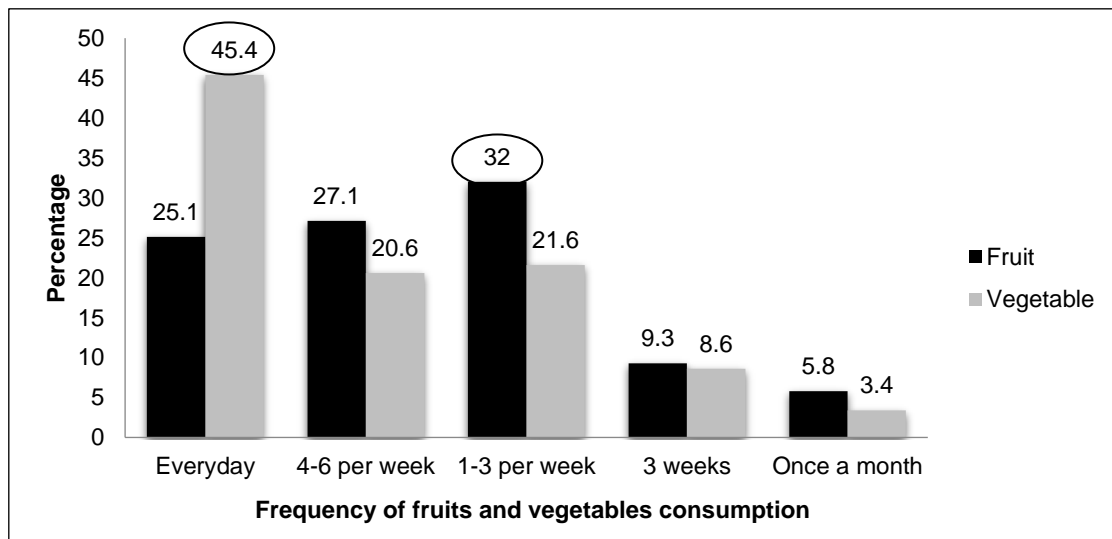
Figure 6: Percentage of frequency of fruits and vegetables consumption

Preference for the types of fruits and vegetables consumed by respondents
Figure 7 shows that 86.2% prefer to eat at least 1 type of vegetables while 93.2% prefer to eat at least 1 type of fruits.
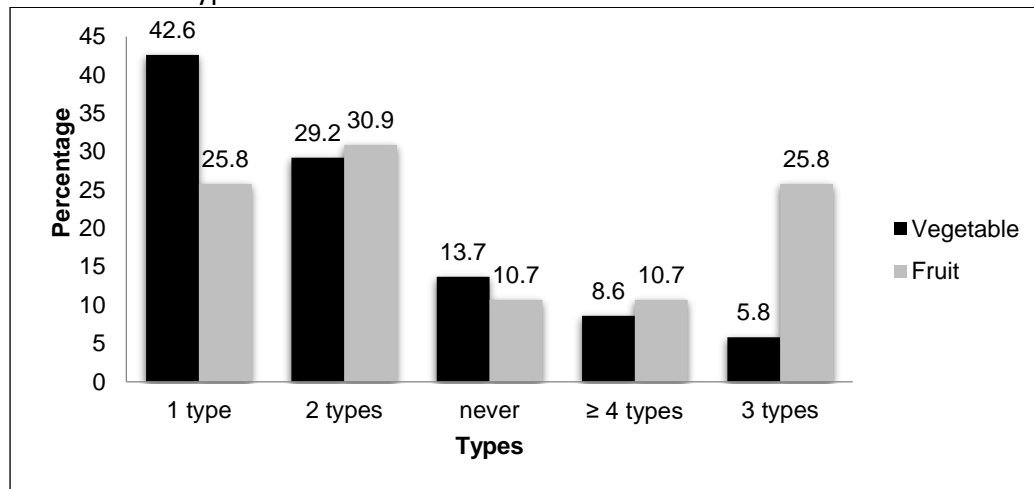
Figure 7: Preference for types of fruits and vegetables consumed by respondents

Vegetables Intake among Adults
Figure 8 shows that garlic and onion were highly consumed daily by majority respondents. At least 60% prefer to eat both these vegetables every day. While, more than 50% of the respondents ate leafy green, salad, fruit vegetable, cruciferous, legume and roots 1 to 6 times per week. However, at least 40% of the respondents never ate stem vegetables.
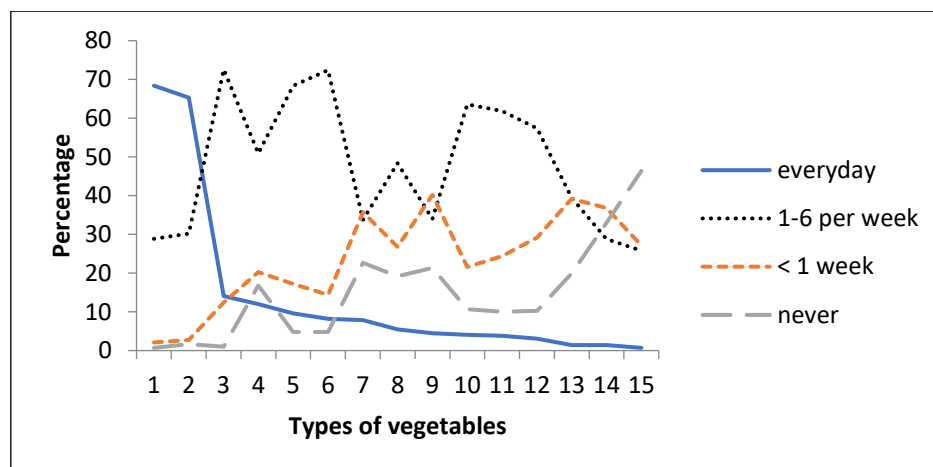
Figure 8: Percentage of vegetables intake

1	Onion	6	Cruciferous	11	Roots
2	Garlic	7	Dry fruits	12	Roots
3	Leafy Green	8	Shoot	13	Mushroom
4	Salad	9	Nuts	14	Soyabean, tofu, tempeh
5	Fruit vegetable	10	Legume	15	Stem

Fruits Intake among Adults

Figure 9 shows that orange, watermelon, banana and guava were highly consumed by most respondents. At least 60% prefer to eat all these fruits 1 to 6 times per week. While, more than 40% of the respondents ate pineapple and grape less than once time a week.
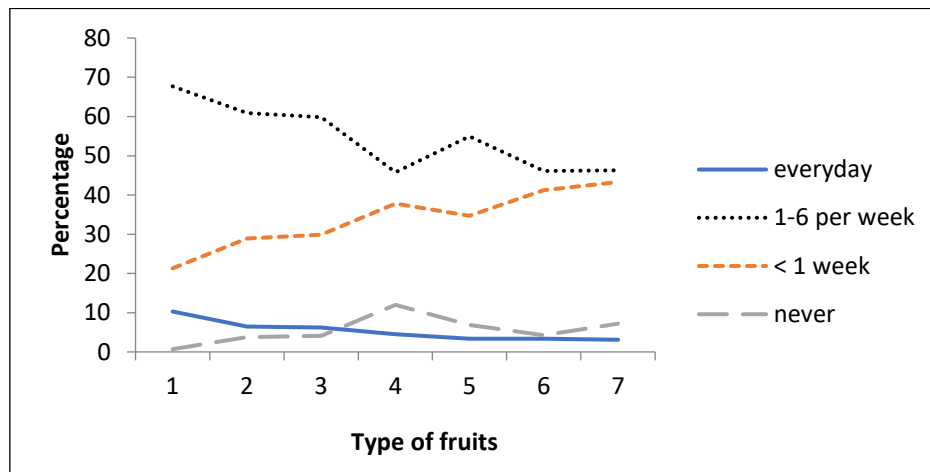
Figure 9
Percentage of fruits intake

1	Orange	3	Banana	5	Papaya	7	Grape
2	Watermelon	4	Guava	6	Pineapple		

Reasons for not consuming fruits and vegetables

Figure 10 presents reasons for not consuming fruits and vegetables. Three main reasons for respondents either eating less or did not eat vegetables are:

- Afraid of pesticides used (40.5%)
- Vegetables cannot be kept long (32.0%)
- Prefer to eat other food (22.3%)
      Three main reasons for respondents either eating less or did not eat fruits are:
- Fruits cannot be kept long (37.5%)
- Afraid of pesticides used (29.6%)
- Too expensive (24.4%)
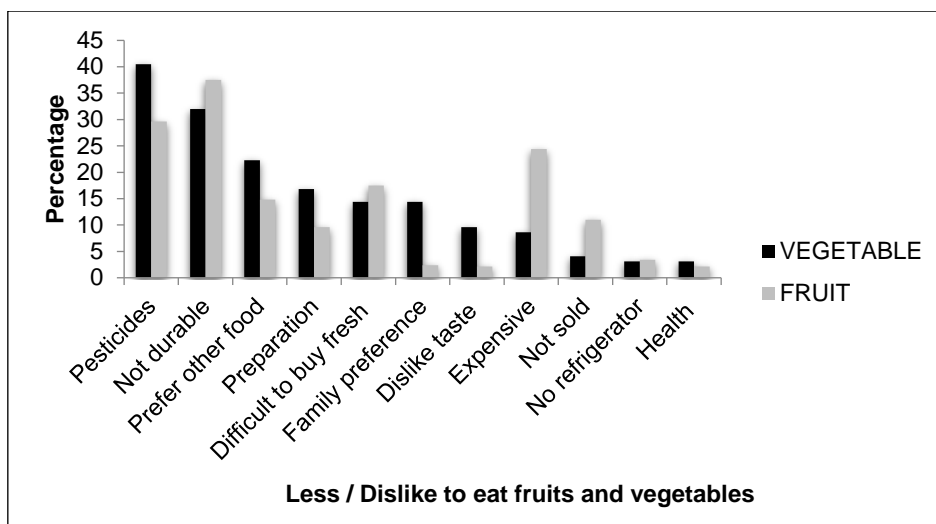
Figure 10: Reasons for not consuming fruits and vegetables

Test of association between frequency of vegetables consumption and profile of respondents (race, gender and age group)
Based on Table 2, it shows that there is a significant association between frequency of vegetables consumption and gender (p = 0.035 < 0.05). However, there is no association between frequency of vegetables consumption with race and age categories.

Table 2
Chi-square test of independence between frequency of vegetables consumption and profile of respondents (race, gender and age group)

Variables	Category	Chi-square test	p-value
Race	Malay	7.797	0.099
	Non-Malay		
Gender	Male	10.327	**0.035***
	Female		
Age	< 30	11.341	0.183
	31-49		
	>50		

Significant at 0.05

Since gender and frequency of vegetables consumption is significant, this study is proceeded by analyzing result that obtained in Table 3.

Table 3
Crosstabulation between gender and frequency of vegetables consumption

gender * freq_veg_cons Crosstabulation

				freq_veg_cons					
			Once a month	3 weeks	1-3 per week	4-6 per week	everyday	Total
gender	female	Count	4	13	35	26	87	165
		Expected Count	5.7	14.2	35.8	34.1	75.1	165.0
		% within gender	2.4%	7.9%	21.2%	15.8%	52.7%	100.0%
		% within freq_veg_cons	40.0%	52.0%	55.6%	43.3%	65.9%	56.9%
		Adjusted Residual	-1.1	-.5	-.2	-2.4	2.8	
	male	Count	6	12	28	34	45	125
		Expected Count	4.3	10.8	27.2	25.9	56.9	125.0
		% within gender	4.8%	9.6%	22.4%	27.2%	36.0%	100.0%
		% within freq_veg_cons	60.0%	48.0%	44.4%	56.7%	34.1%	43.1%
		Adjusted Residual	1.1	.5	.2	2.4	-2.8	
Total		Count	10	25	63	60	132	290
		Expected Count	10.0	25.0	63.0	60.0	132.0	290.0
		% within gender	3.4%	8.6%	21.7%	20.7%	45.5%	100.0%
		% within freq_veg_cons	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Based on Table 3, it was found 65.9% of the respondents who ate vegetable everyday are female, while 34.1% are male. And, 56.7% of the respondents who ate vegetable within 4 to 6 times per week are male, while 43.3% are female.

Test of association between frequency of fruits consumption and profile of respondents (race, gender and age group)
Table 4
Chi-square test of independence between frequency of fruits consumption and profile of respondents (race, gender and age group)

Variables	Category	Chi-square test	p-value
Race	Malay	11.271	**0.024***
	Non-Malay		
Gender	Male	6.260	0.181
	Female		
Age	< 30	22.594	**0.004***
	31-49		
	>50		

Significant at 0.05

Table 4 shows that there are significant associations between frequency of fruits consumption with race (p = 0.024 < 0.05) and age (p = 0.004 < 0.05) categories. However, there is no association between frequency of fruits consumption and gender.

Since race and frequency of fruits consumption and age group and frequency of fruits consumption are significant, this study is proceeded by analyzing result that obtained in Table 5 and Table 6.

Table 5
Crosstabulation between race and frequency of fruits consumption

					freq_fruit_cons			
			Once a month	3 weeks	1-3 per week	4-6 per week	everyday	Total
race	malay	Count	17	24	87	65	58	251
		Expected Count	14.8	23.4	80.8	68.6	63.4	251.0
		% within race	6.8%	9.6%	34.7%	25.9%	23.1%	100.0%
		% within freq_fruit_cons	100.0%	88.9%	93.5%	82.3%	79.5%	86.9%
		Adjusted Residual	1.7	.3	2.3	-1.4	-2.2	
	non malay	Count	0	3	6	14	15	38
		Expected Count	2.2	3.6	12.2	10.4	9.6	38.0
		% within race	.0%	7.9%	15.8%	36.8%	39.5%	100.0%
		% within freq_fruit_cons	.0%	11.1%	6.5%	17.7%	20.5%	13.1%
		Adjusted Residual	-1.7	-.3	-2.3	1.4	2.2	
Total		Count	17	27	93	79	73	289
		Expected Count	17.0	27.0	93.0	79.0	73.0	289.0
		% within race	5.9%	9.3%	32.2%	27.3%	25.3%	100.0%
		% within freq_fruit_cons	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Based on Table 5, it was found 93.5% of the respondents who ate fruit within 1 to 3 times per week are Malay, while 6.5% are non-Malay. Then, it was found 79.5% of the respondents who ate fruit everyday are Malay, while 20.5% are non-Malay.

Table 6
Crosstabulation between frequency of fruits consumption and age categories

					freq_fruit_cons			
			Once a month	3 weeks	1-3 per week	4-6 per week	everyday	Total
Age	<30	Count	9	13	44	18	24	108
		Expected Count	6.4	10.1	34.8	29.5	27.3	108.0
		% within Age	8.3%	12.0%	40.7%	16.7%	22.2%	100.0%
		% within freq_fruit_cons	52.9%	48.1%	47.3%	22.8%	32.9%	37.4%
		Adjusted Residual	1.4	1.2	2.4	-3.1	-.9	
	30-49	Count	6	13	30	32	29	110
		Expected Count	6.5	10.3	35.4	30.1	27.8	110.0
		% within Age	5.5%	11.8%	27.3%	29.1%	26.4%	100.0%
		% within freq_fruit_cons	35.3%	48.1%	32.3%	40.5%	39.7%	38.1%
		Adjusted Residual	-.2	1.1	-1.4	.5	.3	
	>50	Count	2	1	19	29	20	71
		Expected Count	4.2	6.6	22.8	19.4	17.9	71.0
		% within Age	2.8%	1.4%	26.8%	40.8%	28.2%	100.0%
		% within freq_fruit_cons	11.8%	3.7%	20.4%	36.7%	27.4%	24.6%
		Adjusted Residual	-1.3	-2.6	-1.1	2.9	.6	
Total		Count	17	27	93	79	73	289
		Expected Count	17.0	27.0	93.0	79.0	73.0	289.0
		% within Age	5.9%	9.3%	32.2%	27.3%	25.3%	100.0%
		% within freq_fruit_cons	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Based on Table 6, it was found 40.5% of the respondents who ate fruit within 4 to 6 times per week are people aged between 30 to 49 years old, while 36.7% are 50 and above and 22.8% are less than 30 years old. While, it was found 47.3% of the respondents who ate fruit within

1 to 3 times per week are people aged less than 30 years old, while 32.3% are 30 to 49 years old, and 20.4% are 50 and above.

Conclusions and Recommendations
In conclusion, the majority of the respondents were married Malay women. Most of them had a high education level and were employed. With such profiles, there are various patterns in the respondents' consumption of fruits and vegetables. The findings indicated that vegetables like garlic and onions are highly consumed daily. Meanwhile, fruit intakes such as oranges, watermelon, bananas and guava were highly consumed by most respondents. The majority of them mentioned that pesticide is the main reason for not consuming vegetables and the main reason for not consuming fruits is that they cannot be kept long. So, the government should examine ways to make fruits and vegetables more consumable for society.

This study also found that half of the respondents did not know the daily recommended servings of fruits and vegetables. Therefore, more effort is needed from the government to encourage Malaysians to eat five or more servings of fruits and vegetables every day in the context of a low-fat and high-fiber diet. Aside from that, this study also revealed that there are significant associations in the frequency of fruits consumption between race and age categories. There is also a significant association between the frequency of vegetables consumption and gender. From the study, many respondents did not know that fruits and vegetables contained lots of nutrients. Therefore, there is a need to educate respondents about the nutrient content and the importance of increasing their consumption of fruits and vegetables. These education programs must consider the trade-off required for families to purchase more fruits and vegetables.

This study demonstrates the fruits and vegetables consumption among adults in Malaysia. The study's findings point to the need for fresh, improved efforts aimed at increasing adult Malaysians' consumption of fruits and vegetables. This study is expected to give benefits to the government, which should pay more attention in order to overcome the perceived barriers that are associated with achieving the recommended national guidelines for fruit and vegetable intakes among adults. Aside from that, this study is also significant to adults since they will learn the importance of their health by increasing fruits and vegetables consumption in their daily life.

As for recommendations, all the respondents were chosen according to race. Therefore, the ethnic variation in this study was incomparable to other studies because the majority of the respondents comprised more Malay than any other race (Chinese, Indian, and Siamese). Therefore, this problem did not allow for local comparison between Malay and non-Malay. Hence, it is recommended that similar studies be conducted with more representation from the other race groups. It also suggested that for future research, they should use different statistical methods to gain more information on attitudes and knowledge on fruits and vegetables consumption patterns among Malaysian adults as well as to improve what has been left in the current research.

References

Alkazemi, D., & Salmean, Y. (2021). Fruit and vegetable intake and barriers to their consumption among university students in Kuwait: a cross-sectional survey. *Journal of Environmental and Public Health*, *2021*.

Andreyeva, T., Blumenthal, D. M., Schwartz, M. B., Long, M. W., & Brownell, K. D. (2008). Availability and prices of foods across stores and neighborhoods: the case of New Haven, Connecticut. *Health Affairs*, *27*(5), 1381-1388.

Aune, D., Giovannucci, E., Boffetta, P., Fadnes, L. T., Keum, N., Norat, T., ... & Tonstad, S. (2017). Fruit and vegetable intake and the risk of cardiovascular disease, total cancer and all-cause mortality—a systematic review and dose-response meta-analysis of prospective studies. *International journal of epidemiology*, 46(3), 1029-1056.

Bhargava, A., & Bansal, A. (2021). Fruits and vegetables quality evaluation using computer vision: A review. *Journal of King Saud University-Computer and Information Sciences*, *33*(3), 243-257.

Blitstein, J. L., Snider, J., & Evans, W. D. (2012). Perceptions of the food shopping environment are associated with greater consumption of fruits and vegetables. *Public health nutrition*, *15*(6), 1124-1129.

Cassady, D., Jetter, K. M., & Culp, J. (2007). Is price a barrier to eating more fruits and vegetables for low-income families?. *Journal of the American Dietetic Association*, *107*(11), 1909-1915.

Choi, Y., Lee, J. E., Bae, J. M., Li, Z. M., Kim, D. H., Lee, M. S., ... & Shin, M. H. (2015). Vegetable intake, but not fruit intake, is associated with a reduction in the risk of cancer incidence and mortality in middle-aged Korean men. The Journal of nutrition, 145(6), 1249-1255.

Dittus, K. L., Hillers, V. N., & Beerman, K. A. (1995). Benefits and barriers to fruit and vegetable intake: relationship between attitudes and consumption. *Journal of Nutrition Education*, *27*(3), 120-126.

Dubey, S. R., & Jalal, A. S. (2015). Application of image processing in fruit and vegetable analysis: a review. *Journal of Intelligent Systems*, *24*(4), 405-424.

Duthie, S. J., Duthie, G. G., Russell, W. R., Kyle, J. A., Macdiarmid, J. I., Rungapamestry, V., ... & Bestwick, C. S. (2018). Effect of increasing fruit and vegetable intake by dietary intervention on nutritional biomarkers and attitudes to dietary change: a randomised trial. *European journal of nutrition*, *57*(5), 1855-1872.

El Bcheraoui, C., Basulaiman, M., AlMazroa, M. A., Tuffaha, M., Daoud, F., Wilson, S., ... & Mokdad, A. H. (2015). Fruit and vegetable consumption among adults in Saudi Arabia, 2013. *Nutrition and Dietary Supplements*, *7*, 41-49.

Gavin, M. L. (2009). "The Food Guide Pyramid" [On-line]. Available at http://kidshealth.org/parent/nutrition_fit/nutrition/pyramid.html#

Glasson, C., Chapman, K., & James, E. (2011). Fruit and vegetables should be targeted separately in health promotion programmes: differences in consumption levels, barriers, knowledge and stages of readiness for change. *Public health nutrition*, *14*(4), 694-701.

Hameed, K., Chai, D., & Rassau, A. (2018). A comprehensive review of fruit and vegetable classification techniques. *Image and Vision Computing*, *80*, 24-44.

Harasym, J., & Oledzki, R. (2014). Effect of fruit and vegetable antioxidants on total antioxidant capacity of blood plasma. *Nutrition*, *30*(5), 511-517.

Haynes-Maslow, L., Parsons, S. E., Wheeler, S. B., & Leone, L. A. (2013). Peer reviewed: a qualitative study of perceived barriers to fruit and vegetable consumption among low-income populations, North Carolina, 2011. *Preventing chronic disease*, *10*.

Hong, S. A., Kim, K., & Kim, M. K. (2012). Educational attainment and differences in fruit and vegetable consumption among middle-aged adults in the Korean National Health and Nutrition Examination Survey IV. *Nutrition Research and Practice*, *6*(3), 263-269.

Izzah, A. N., Aminah, A., Pauzi, A. M., Lee, Y. H., Wan Rozita, W. M., & Fatimah, D. S. (2012). Patterns of fruits and vegetable consumption among adults of different ethnics in Selangor, Malaysia. *International Food Research Journal*, *19*(3).

Kirkpatrick, S. I., Dodd, K. W., Reedy, J., & Krebs-Smith, S. M. (2012). Income and race/ethnicity are associated with adherence to food-based dietary guidance among US adults and children. *Journal of the Academy of Nutrition and Dietetics*, *112*(5), 624-635.

Lampe, J. W. (1999). Health effects of vegetables and fruit: assessing mechanisms of action in human experimental studies. *The American journal of clinical nutrition*, *70*(3), 475s-490s.

Leitzmann, C. (2016). Characteristics and health benefits of phytochemicals. *Complementary Medicine Research*, *23*(2), 69-74.

Lo, Y. L., Lee, S. S., & Cheng, S. H. (2022). Inadequate fruits and vegetables consumption among Malaysian adults during the COVID-19 pandemic. *Nutrition and health*, 02601060221099782.

Lock, K., Pomerleau, J., Causer, L., Altmann, D. R., & McKee, M. (2005). The global burden of disease attributable to low consumption of fruit and vegetables: implications for the global strategy on diet. *Bulletin of the World health Organization*, *83*(2), 100-108.

McGuire, S. (2011). US department of agriculture and US department of health and human services, dietary guidelines for Americans, 2010. Washington, DC: US government printing office, January 2011. *Advances in nutrition*, *2*(3), 293-294.

Mook, K., Laraia, B. A., Oddo, V. M., & Jones-Smith, J. C. (2016). Food Security Status and Barriers to Fruit and Vegetable Consumption in Two Economically Deprived Communities of Oakland, California, 2013-2014. *Preventing chronic disease*, *13*(2), E21.

Olatona, F. A., Sosanya, A., Sholeye, O. O., Obrutu, O. E., & Nnoaham, K. E. (2018). Knowledge of fruits and vegetables, consumption pattern and associated factors among adults in Lagos State, Nigeria. *Research Journal of Health Sciences*, *6*(2), 50-62.

Othman, K. I., Ab Karim, M. S., Karim, R., Adzhan, N. M., & Abd Halim, N. (2013). Consumption pattern on fruits and vegetables among adults: a case of Malaysia. *Academic Journal of Interdisciplinary Studies*, *2*(8), 424.

Othman, K. I., Ab Karim, M. S., Karim, R., Adzhan, N., Halim, N. A., & Osman, S. (2012). Factors influencing fruits and vegetables consumption behaviour among adults in Malaysia. *Journal of Agribusiness Marketing, Vol. 5, December 2012, p. 29-46.*

Pennington, J. A., & Fisher, R. A. (2009). Classification of fruits and vegetables. *Journal of Food Composition and Analysis*, *22*, S23-S31.

Perera, T., & Madhujith, T. (2012). The pattern of consumption of fruits and vegetables by undergraduate students: a case study. *Tropical Agricultural Research*, *23*(3).

Pollard, C., Miller, M., Woodman, R. J., Meng, R., & Binns, C. (2009). Changes in knowledge, beliefs, and behaviors related to fruit and vegetable consumption among Western Australian adults from 1995 to 2004. *American Journal of Public Health*, *99*(2), 355-361.

Ragini, M. M., Lavanya, D., Likitha, B., SivaRam, A., & Narayana, C. Y. (2020). Classification of Fruits and Vegetables with Its Nutrients.

Schatzer, M., Rust, P., & Elmadfa, I. (2010). Fruit and vegetable intake in Austrian adults: intake frequency, serving sizes, reasons for and barriers to consumption, and potential for increasing consumption. *Public health nutrition*, *13*(4), 480-487.

Sekaran, U. (2005). Research Methods for Business: A skill building approach. *Fourth Edition*.

Slavin, J. L., & Lloyd, B. (2012). Health benefits of fruits and vegetables. *Advances in nutrition*, *3*(4), 506-516.

Williams, L. K., Thornton, L., & Crawford, D. (2012). Optimising women's diets. An examination of factors that promote healthy eating and reduce the likelihood of unhealthy eating. *Appetite*, *59*(1), 41-46.

World Health Organization. (2003). Diet, nutrition, and the prevention of chronic diseases: report of a joint WHO/FAO expert consultation (Vol. 916). World Health Organization.

Yeh, M. C., Obenchain, J., & Viladrich, A. (2010). Barriers and facilitating factors affecting fruit and vegetable consumption. In *Bioactive foods in promoting health* (pp. 85-98). Academic Press.