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Awareness Regarding the Usage of Repeatedly Heated Cooking Oil in Kuala Lumpur, Malaysia.

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ABSTRACT

Reusing cooking oil is a common practice in Malaysia. Oxidation and hydrolysis occur when oil is heated repeatedly due to thermal decomposition. It had been suggested that consumption of repeatedly heated oil could be a health hazard. It is therefore interesting to measure the awareness level amongst Kuala Lumpur residents regarding the usage of repeatedly heated cooking oil. A cross-sectional study was conducted to assess the level of awareness based on knowledge, attitude and practice regarding the usage of repeatedly heated cooking oil. The study involved convenience sampling of 500 respondents at various locations in Kuala Lumpur within a one-month period (April 2009). A questionnaire was designed as a tool to collect data from the respondents by face-to-face interview. It was found that the mean awareness score of Kuala Lumpur residents was moderate (7.8 out of 12 points) with the majority of respondents (42%) scoring moderately in their level of awareness regarding the usage of repeatedly heated cooking oil. Respondents with higher level of education and the highest level of income had significantly higher level of awareness regarding this issue. There was also a significant relationship between respondents' knowledge with their attitude and practice regarding the usage of repeatedly heated cooking oil. The results showed that Kuala Lumpur residents' awareness on the usage of repeatedly heated cooking oil needs to be increased. More aggressive public education campaign regarding this unhealthy practice is needed, which might help improve the health status of the general population.

Keywords: Repeatedly heated cooking oil, frying, health, awareness, Kuala Lumpur residents.

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INTRODUCTION

In order to cut costs and save money, some households repeatedly used cooking oil for frying food. The oil is discarded only when it becomes foamy, emits bad odour or when the colour turns dark [1]. Chemical reactions such as oxidation, hydrolysis and thermal polymerization occur when cooking oil is heated during the frying process [2]. These reactions change the physico-chemical nature of the cooking oil. The quality of oil deteriorates with increased length of frying time due to the accelerated formation of oxidized and polymerized lipid species in the frying medium. If the physico-chemical properties of cooking oil deteriorate, the oil must be discarded because it can prove to be harmful for human consumption. The rate of formation of cooking oil decomposition products depends on the type of food being fried, the type of oil used and the design of the fryer [2].

The consumption of repeatedly heated cooking oil is unhealthy. In the process of frying food, cooking oil is often exposed to high temperatures for long periods of time. This practice generates lipid peroxidation products that may be harmful for human health [3]. The presence of excess polar compounds in repeatedly used frying oil has been associated with increased risk of developing hypertension [4]. Consumption of repeatedly heated cooking oil might increase the risk of developing atherosclerosis. Lipid peroxidation products induce oxidative stress in endothelial cells, resulting in endothelial dysfunction that could eventually lead to the formation of atherosclerosis [5]. Consumption of repeatedly heated cooking oil is also associated with increased total serum lipid and low density lipoprotein (LDL) levels [6] .

A recent study conducted in our department showed that consumption of soy oil that has been repeatedly heated might cause an increase in lipid peroxidation and LDL in ovariectomized female rats (which simulates a post-menopausal state with oestrogen deficiency in humans) [7]. The results of that particular study therefore suggested that repeated heating gradually diminished the protective effects of soy oil and may contribute to the pathogenesis of atherosclerosis in post-menopausal women [7]. Another recent study conducted in our department showed that consumption of repeatedly heated cooking oil resulted in increased blood pressure and necrosis of cardiac tissues in experimental rats [8].

Studies done to gauge the general public awareness on the dangers of consuming repeatedly heated cooking oil are lacking. Most studies of this nature have focused on food outlet operators as target groups. For example, a study conducted in New Zealand showed that most of the food outlet operators were aware and compliant of the guideline regarding the usage of frying oil [9]. In Malaysia, no study has ever been done to determine the general public awareness regarding the usage of repeatedly heated cooking oil. In view of the possible detrimental effects of consuming repeatedly heated cooking oil towards our health, this particular study was conducted in order to determine the level of awareness regarding the usage of repeatedly heated cooking oil amongst Kuala Lumpur residents. It provided a snapshot of the level of knowledge, attitude and practice of the general public in Kuala Lumpur with regards to the usage of repeatedly heated cooking oil.

METHODS

Study design

This cross-sectional study was conducted throughout the month of April 2009 at twenty (20) selected locations in Kuala Lumpur. The relevant data was collected from the respondents by individual face-to face interview with the help of a questionnaire.

Study population

The study population is made up of Kuala Lumpur residents. The study involved convenience sampling of 500 respondents from the general public population at 20 selected locations in Kuala Lumpur (25 respondents per selected area). These locations include areas such as Wangsa Maju, Keramat, Bandar Tun Hussein Onn, Sentul, Taman Tun Dr Ismail, Taman Kepong, Titiwangsa, Bandar Tun Razak, Pantai Dalam, Kampung Malaysia Tambahan, Kampung Baru, Bandar Sri Damansara, Jalan Kuchai Lama, Sri Petaling & Bukit Jalil, Setiawangsa, Bangsar, Taman Maluri, Kampung Pandan, Gombak and Jalan Klang Lama. These locations were chosen because they represent typical residential areas within Kuala Lumpur. The inclusion criteria were citizens of Malaysia who are residents of Kuala Lumpur aged 18 and above, belonging to either any of three

major ethnic groups in Malaysia (Malay, Chinese and Indian) and of both genders, and have experience in using and handling cooking oil for frying food. Participants were excluded if they are not residents of Kuala Lumpur, less than 18 years old and have no experience in using cooking oil. Informed consent was obtained from all participating subjects.

Questionnaires

Questionnaires were written in English and Malay. The survey was carried out within 4 weeks in April 2009. Willing participants of this survey were subjected to face-to-face interview in order to get them to answer the questions found in the questionnaires. The questions were divided into three parts, i.e. parts A, B and C. The respondents were required to provide demographic data such as age, sex, educational level, monthly income and occupation in Part A of the questionnaire. The level of knowledge on the usage of repeatedly heated oil was evaluated in Part B, whereby the respondents were asked on the factors affecting the quality of frying oil, the effect of heating cooking oil repeatedly etc. The attitude and practice on the usage of repeatedly heated cooking oil were evaluated in Part C, where, for example, the respondents were asked about the number of times they use the same cooking oil before discarding it, the ways in which they try to maintain the quality of cooking oil etc. The questionnaires were pre-tested on 50 respondents from the Kuala Lumpur general public population before the official survey was performed. Based on the feedback from respondents, some of the questions were modified for the real study. All data collected was made anonymous, stored and controlled by the authors.

Statistical analysis

Data was analyzed using SPSS version 16. Descriptive statistics, including frequencies and percentages, were calculated for each item in Part A of the questionnaire. In order to evaluate the level of awareness regarding the topic, each respondent was given a score for selected questions in Parts B and C. A score of 1 was given if they answered a question correctly, otherwise nil (0) mark was given. The scores obtained from Parts B and C was then summed up in order to obtain the respondents' awareness scores and subsequently classified into three levels of awareness according to the total score obtained i.e. low (0-4), moderate (5-8) or high (9-12) (Table 1). Statistical tests used include the Student's t-test, one-way ANOVA, Chi-Square test and Pearson's correlation. A p-value of < 0.05 was considered to be statistically significant. Analyses were made by using SPSS software (version 16; SPSS Inc, Chicago).

Table 1: Level of awareness

Level of awareness	Score of correct answers
High	9-12
Moderate	5-8
Low	0-4

Student's t-test, one-way ANOVA and Pearson's correlation were performed later on in order to establish whether there is any significant relationship between the level of awareness with knowledge and attitude and practice. The significance level (p value) was set at 0.05.

Hypothesis

There were several hypotheses in this study: 1) There is no significant relationship between gender and awareness regarding usage of repeatedly heated cooking oil. 2) There is no significant relationship between income and awareness regarding usage of repeatedly heated cooking oil. 3) There is no significant relationship between educational level and level of awareness regarding usage of repeatedly heated cooking oil. 4) There is no significant relationship between knowledge with attitude and practice regarding usage of repeatedly heated cooking oil.

Ethical consideration

The Human Research and Ethics Committee, Universiti Kebangsaan Malaysia, has reviewed and approved this study with respect to the methodology and ethical considerations.

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RESULTS

Demographic data

A total of 500 respondents from the general public in Kuala Lumpur were enrolled in this survey. The age of respondents ranged from 18 to 77, with the mean age being 35 years old (Figure 1). The largest number of respondents (106) was in the 18-22 age group, whereas the smallest number of respondents (3) was in the 73-77 age group (Figure 1). 66.4% of the respondents were females. Most of the respondents were Malay (72.2%), followed by Chinese (19.0%) and Indian (8.8%). The majority of the respondents' educational level was up to secondary school level (42%). Most of the respondents were either students (25.8%) or those working in the private sector/non-governmental organizations (23.6%). Over half (61%) of the respondents have a monthly income of less than RM 1000. An overwhelming majority of the respondents claim to use palm oil for frying food (88.4%). Other details of the demographic data are shown in Table 2.

Table 2: Demographic data of Kuala Lumpur public respondents

Data	Numbers and percentage
Number of subjects (N)	500 (100%)
Gender	
Male	168 (33.6%)
Female	332 (66.4%)
Race	
Malay	361 (72.2%)
Chinese	95 (19.0%)
Indian	44 (8.8%)
Respondents' educational level	
None	29 (6%)
Primary school	74 (15%)
Secondary school	210 (42%)
Diploma	49 (10%)
Degree & above	138 (27%)
Respondents' occupation	
Government servants	61 (12.2%)
Non-government employees	118 (23.6%)
Self-employed	83 (16.6%)
Student	129 (25.8%)
Homemaker	80 (16%)
Retired/Pensioner	17 (3.4%)
Unemployed	12 (2.4%)
Respondents' monthly income	
<RM1000	308 (61.6%)
RM1001-4000	143 (28.6%)
>RM4000	49 (9.8%)
Types of oil used for frying	
Palm oil	442 (88.4 %)
Peanut oil	33 (6.6%)
Corn oil	14 (2.8%)
Soy oil	2 (0.4%)
Olive oil	1 (0.2%)
Coconut oil	8 (1.6%)

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Knowledge of the usage of repeatedly heated cooking oil

Table 3.Respondents' knowledge of the usage of repeatedly heated cooking oil

Questions	Numbers and percentage
1. Usage of repeatedly heated cooking oil for frying food is a good practice as it saves cost and there is no side effect.	
Agree	124 (24.8%)
Disagree	340 (68.0%)
Not sure	36 (7.2%)
2. The quality of oil used for frying will remain the same regardless of how many times the oil is reheated.	
Agree	
Disagree	65 (13.0%)
Not sure	394 (78.8%)
	41 (8.2%)
3. We can use the oil for many times and discard it only when it turns dark.	
Agree	
Disagree	125 (25.0%)
Not sure	342 (68.4%)
	33 (6.6%)
4. There will be loss of nutrients in the repeatedly heated cooking oil used for frying.	
Agree	
Disagree	265 (53.0%)
Not sure	100 (20.0%)
	135 (27.0%)
5. The type of cooking oil does not influence the type of by-products produced from the repeatedly heated cooking oil.	
Agree	
Disagree	202 (40.4%)
Not sure	144 (28.8%)
	154 (30.8%)
6. Will repeatedly heated cooking oil used for frying cause bad effects to our health?	
Yes	
No	398 (79.6%)
Not sure	45 (9.0%)
	57 (11.4%)
7. For the 398 respondents who answered "yes" to the above question (question no. 6), what type of disease do they associate with the consumption of repeatedly heated cooking oil?	
Gout	
Tuberculosis	14 (3.5%)
Diabetes	12 (3.0%)
Hypertension	12 (3.0%)
Cancer	120 (30.2%)
	240 (60.3%)

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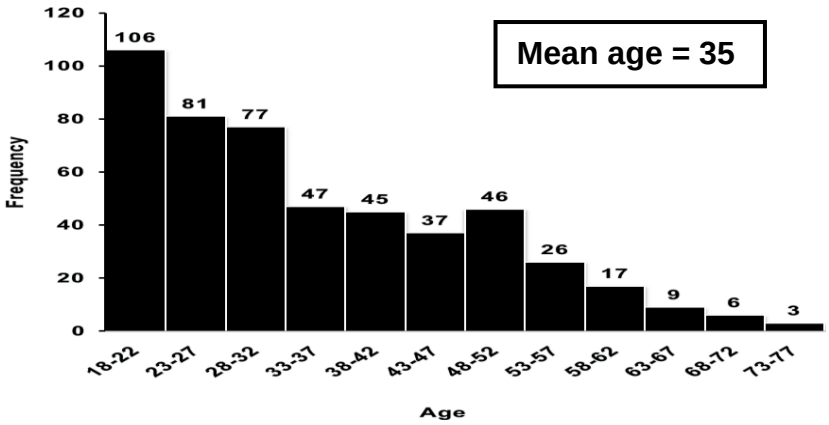

Figure 1: Number of respondents by age

More than half of the respondents (68%) did not agree that the usage of repeatedly heated cooking oil is a good practice. The majority of respondents (79%) disagreed that the quality of cooking oil remains the same regardless of how many times it has been reused for frying. Most of the respondents (68%) also did not agree that cooking oil can be used many times for frying and only be discarded when it turns dark. Slightly more than half of the respondents (53%) agreed that there will be loss of nutrients in the repeatedly heated cooking oil. Less than half (40%) of the respondents agreed that the type of cooking oil utilized does not influence the type of by-products produced from the repeatedly heated cooking oil. The majority (80%) of the respondents agreed that the usage of repeatedly heated cooking oil is bad for health. Of those who agreed that consumption of repeatedly heated cooking oil is bad for health, 60% said that such practice can lead to the formation of cancer. Other details about the knowledge of the respondents on the usage of repeatedly heated cooking oil are shown in Table 3.

Attitude and practice regarding the usage of repeatedly heated cooking oil

73% of respondents admitted that they use cooking oil repeatedly for frying. For those who did not use cooking oil repeatedly for frying, the majority (58%) stated that such practice is harmful to health. For those who use cooking oil repeatedly for frying, more than half admitted that they never use the oil more than twice, whereas only 10% reuse cooking oil four times or more. There were several methods that our respondents practice in order to maintain the quality of cooking oil, the most popular being using stainless steel utensils for frying (92%). The newspaper is the main source of information obtained regarding the issue of using repeatedly heated cooking oil (41%). An overwhelming majority of respondents (83%) wanted to know more about this issue. Other details about the attitude and practice of the respondents regarding the usage of repeatedly heated cooking oil are shown in Table 4.

Level of awareness regarding the usage of regarding the usage of repeatedly heated cooking oil

The knowledge scores of respondents are shown in Figure 2. Nearly half of the respondents scored either 5 or 6 out of 7. The mean (average) knowledge score is 4.6 out of 7. The attitude and practice scores of respondents are shown in Figure 3, where the majority of respondents scored 2, 3 or 4 out of 5. The mean (average) attitude and practice score is 3.1 out of 5. The sum of knowledge score as well as attitude and practice score for each respondent is known as the awareness score. The awareness scores of respondents are shown in Figure 4, where it can be seen that the majority of the respondents scored 7 to 10 out of a maximum of 12. The mean (average) awareness score is 7.8 out of 12. The awareness scores of respondents were then sorted out into 3 categories as illustrated in Table 1 in order to obtain respondents' level of awareness regarding this issue. The respondents' level of awareness is represented in Figure 5, where it can be seen that 47 respondents (20.6%) had low level of awareness, 240 respondents (42%) had moderate level of awareness and 213 respondents (37.4%) had high level of awareness regarding this issue.

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Table 4: Respondents' attitude and practice regarding the usage of repeatedly heated cooking oil

Questions	Numbers and percentage
1. Do you use cooking oil repeatedly for frying?	
Yes	366 (73.2%)
No	134 (26.8%)
2. For the 134 respondents who answered "No" to the above question (question no. 1), what are the reasons for not using repeatedly heated cooking oil for frying?	
Harmful to health	77 (57.5%)
Food will look bad	39 (29.1%)
Increases cooking oil's cholesterol level	11 (8.2%)
No particular reason	7 (5.2%)
3. For the 366 respondents who use the same cooking oil repeatedly for frying, how many times is the cooking oil reused before discarded?	
2 times	204 (55.7%)
3 times	125 (34.2%)
4-10 times	37 (10.1%)
4. Methods attempted in order to maintain the quality of cooking oil	
(a) Using fresh oil for frying every time	
Yes	134 (26.8%)
No	366 (73.2%)
(b) Maintaining a small flame while frying	
Yes	347 (69.4%)
No	153 (30.6%)
(c) Using stainless steel frying utensil	
Yes	462 (92.4%)
No	38 (7.6%)
(d) Storing oil in stainless steel or glass container after usage	
Yes	260 (52%)
No	240 (48%)
(e) Filtering the oil to catch any food particles or foreign matter	
Yes	378 (75.6%)
No	122 (24.4%)
(f) Source where information was obtained regarding the usage of repeatedly heated cooking oil	
Newspaper	207 (41.4%)
Magazine	69 (13.8%)
Television	40 (8%)
Radio	5 (1%)
Internet	52 (10.4%)
Family/Friends/Other people	71 (14.2%)
No prior knowledge about this issue	56 (11.2%)
(g) Do the respondents would like to obtain more information about this issue?	
Yes	413 (82.6%)
No	87 (17.4%)

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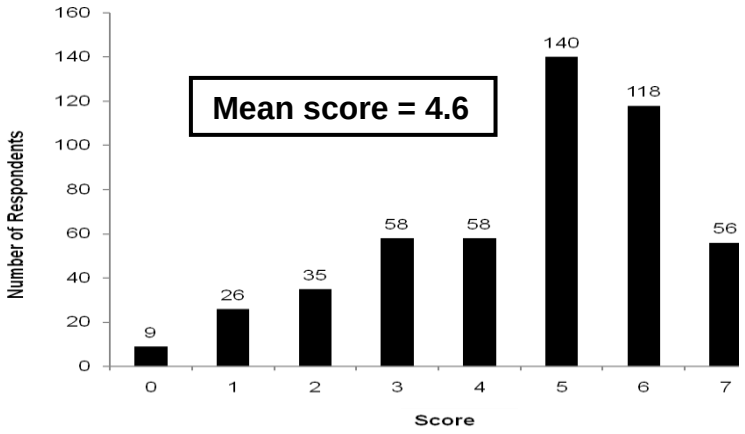
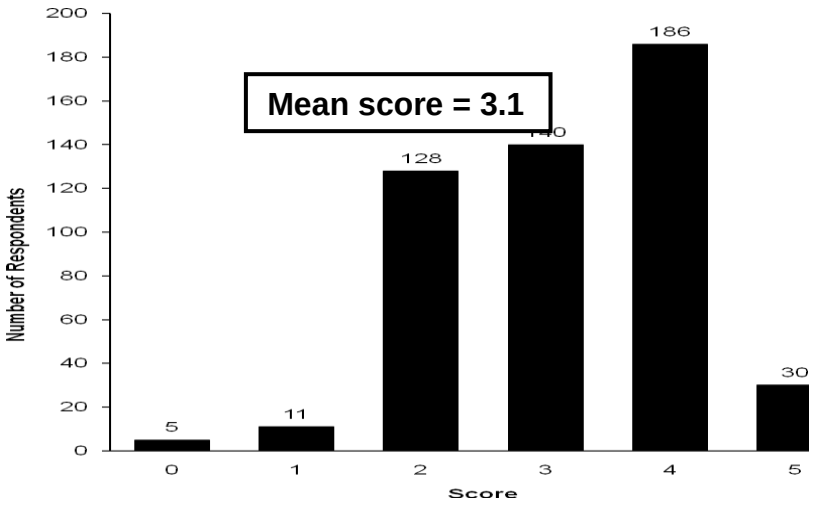
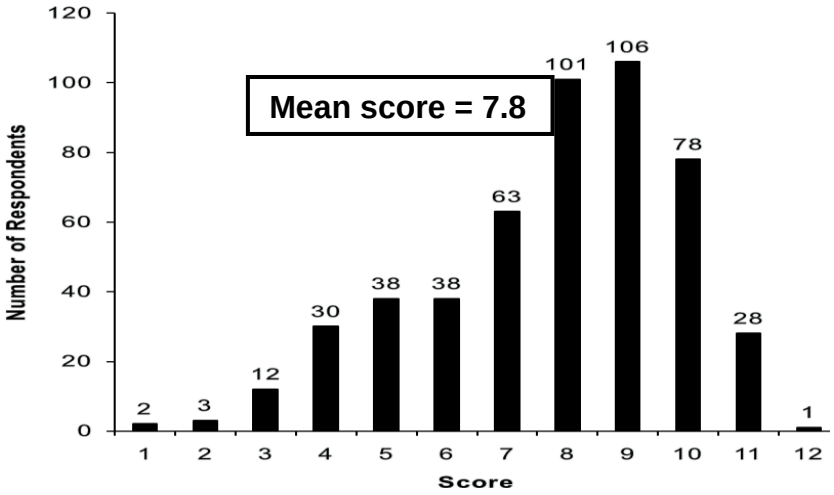


Figure 2: Knowledge scores of respondents





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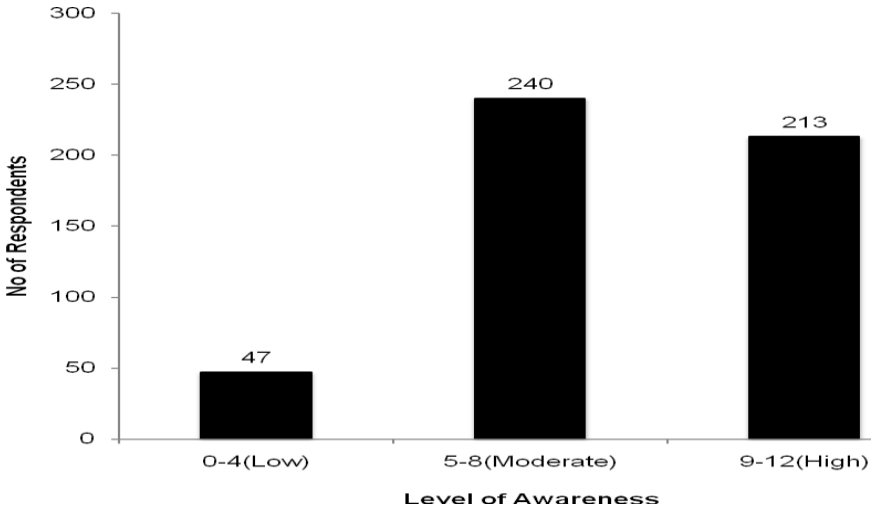

Figure 5: Level of awareness regarding usage of repeatedly heated cooking oil amongst respondents

Factors influencing level of awareness regarding the usage of repeatedly heated cooking oil

There was no significant association between gender and level of awareness regarding the usage of repeatedly heated cooking oil. In terms of income, respondents who earned RM 4000 or more have significantly higher level of awareness than those earning less ($p<0.05$). This might be due to their level of education, where it was found in this study that there was significant association between income and level of education ($\chi 2=106.2$, $p<0.001$). Respondents with higher level of education was found to have significantly higher level of awareness regarding usage of repeatedly heated cooking oil compared to respondents with lower level of education ($p<0.001$). There was also a significant relationship between respondents knowledge with their attitude and practice regarding the usage of repeatedly heated cooking oil ($r=0.121$, $p=0.007$).

DISCUSSION

This study assessed the level of awareness regarding the usage of repeatedly heated cooking oil amongst the urban population of Kuala Lumpur. This population is interesting to study because Kuala Lumpur is the capital city of Malaysia, a developing third world nation that has made astounding progress to become a newly-industrialized country. It is assumed that an urban population is more aware and knowledgeable about health issues compared to a rural population. Therefore, the level of awareness of Kuala Lumpur urban dwellers regarding this little-known health issue can be seen as being representative of the knowledge of a typical urban population of a developing nation in South-East Asia. In total, 500 respondents were surveyed. Unsurprisingly, more than half the respondents which met our inclusion criteria were females due to the reason that in most Malaysian households, women do most of the cooking. The racial breakdown of our respondents also reflect that of the Malaysian population, where the majority are Malays, followed by ethnic Chinese and Indians. The majority of respondents had at least a secondary school (high school) education.

An overwhelming majority of our respondents used palm oil for frying food. This is hardly surprising since Malaysia is currently the world's largest producer and exporter of palm oil [10]. The fact that palm oil is cheaper and widely available in Malaysia also helps made it a popular choice of cooking oil. This is in concordance with the finding that palm oil is the major source of cooking oil in many developing countries [11]. Other types of cooking oil such as soy and corn oil are not popular amongst our respondents. This is in contrast with the findings obtained from a survey done in Costa Rica, a developing Latin American country, where soy, corn and sunflower oils are the preferred cooking oils even though palm oil is cheaper [12]. This is due to aggressive marketing and advertising campaign by private industries, as well as the perception created by certain quarters that these oils are healthier than palm oil [12]. These lifestyle-altering propaganda does not occur in Malaysia, where there has been a strong government-backed public campaign touting the useful health benefits of using palm oil in cooking [13,14].

A large proportion of our respondents were aware that consumption of repeatedly heated cooking oil is not good for health despite not knowing exactly what the detrimental effects are. Their source of information for this particular health issue was limited and some of the respondents have never heard about this issue at all. Despite that, most of them made an effort to maintain the quality of oil used for frying due to various reasons. This is important because a previous study has shown that degradation due to the reuse of vegetable oils, especially sunflower oil, is an independent risk factor for hypertension [4]. However, if the practice of using oil repeatedly for frying is necessary due to economic reasons, then palm oil would be the better choice. Palm oil seems to be able to withstand being repeatedly heated better than soy oil. Previous studies have suggested that the unique composition of palm oil allows it to withstand heat better than soy oil. Firstly, it is rich in monounsaturated fatty acids (MUFA) but has low level of polyunsaturated fatty acids (PUFA) compared to soy oil [15]. PUFA is more easily oxidized compared to MUFA [16]. Repeated heating of vegetable oil high in PUFA results in formation of toxic compounds that increased the risk of hypertension, whereas oils that are rich in MUFA such as palm oil and olive oil can better withstand oxidation and formed less degradation products when they are heated (4). Secondly, palm oil is rich in vitamin E, which may play an important role in its ability to withstand thermal oxidative changes. Inclusion of α-tocopherol to frying oil was found to render PUFA more resistant to oxidation [17]. Vitamin E, which effectively protects fatty acids in the oil from oxidation, deteriorates after each frying episode [18]. Therefore, repeated heating of frying oils destroys the vitamin E content and exposes the fatty acids to oxidation. The vitamin E content of palm oil mainly consists of tocotrienols, while the main vitamin E in soy oil is tocopherols [19]. Tocotrienols have better antioxidant capacity than tocopherols [20,21] and this may contribute to the better resistance to oxidative changes due to repeated heating of palm oil.

Most of our respondents in the survey do reuse cooking oil for frying 2-3 times before discarding it. This is not too bad since most of them used palm oil for frying, which can withstand thermal oxidation quite well, as mentioned in the previous paragraph. Those who use fresh oil for frying every time do so either because they think it is a healthy practice or because they think it improves the appearance of fried food. In order to maintain the quality of oil during frying, the majority of respondents claim to use stainless steel frying utensils. This is a good practice, since low concentration of copper found in brass and other copper alloy utensils is a catalyst for thermal oxidation [22]. The majority of respondents also maintain a small flame while frying, which is also a good practice because very high temperatures can decompose cooking oil very rapidly [22].

One important factor found in this study which was observed to play a vital role in improving awareness about this issue is the level of education attained by respondents. This study revealed that there was a significant relationship between the educational level and the level of awareness about the usage of repeatedly heated cooking oil. Thus it can be concluded from this study that those with higher educational level were more aware of this issue. The reason might be that those who are more educated would be able to gain more information from the resources that are made available to them. For example, from this study, we found that the major source of information regarding this issue was from the newspapers. We can therefore assume that those who are less educated might be less interested in reading health columns in the newspapers compared to those who are more educated. This study also showed that there is a link between the level of knowledge and the attitude and practice in the usage of repeatedly heated cooking oil. We can therefore assume that those with adequate knowledge regarding this issue would have good practice in the usage of cooking oil because they were more aware of the detrimental effects of consuming repeatedly heated cooking oil.

There were some limitations in this study as convenience sampling was done in order to obtain our respondents for the survey due to time and financial constraints. The data obtained would have been more concrete if identified households within a targeted population had been selected and further stratified according to their socioeconomic standing, educational status, health status and occupational nature. More information regarding healthy eating practices and behaviours would have added greatly to the variables that suggest health awareness. It is also difficult to interpret associations regarding gender since the majority of the respondents were female, and also because the male and female respondents in our study do not represent couples within a household. Other factors relating to lifestyle or health awareness (e.g. frequency of exercise, reported history of having diseases such as diabetes or hypertension, smoking, etc.) which we did not take into account in our study may also be important determinants with regards to the practice of using repeatedly heated cooking oil. Another drawback of our study is that since we did not make home visits, we had to rely

totally on the honesty of the respondents in obtaining the answers to our questions. Therefore, the actual type of oils used at respondents' households as well as the quality of reheated oils was not validated by visual identification and laboratory analysis.

Fried foods are well-liked by consumers due to their taste, smell and texture. Frying is also one of the easiest and cheapest ways of cooking, thus making it a popular choice especially for the lower income group. Even though a certain amount of potentially toxic products are produced during frying (such as polar compounds or polymers), fried foods are generally considered safe [23,24]. It is only when frying oil is used repeatedly that it becomes toxic for human consumption [4]. A recent study showed that in a home environment, people who use sunflower oil more often have a high proportion of polar compounds and polymers in their cooking oil [25]. That particular study also showed that the concentration of polar compounds and polymers in oil used for frying depends on the way they are subjected to. For example, a higher proportion of polar compounds and polymers were found in oils subjected to deep frying [25]. The evaluation and quantification of toxic compounds produced by the improper use of cooking oils in home kitchens is not usually covered in previously attempted nutritional public health surveys. It has been described that people belonging to the lower income group gave more priority to foods that are socially acceptable than to the quality of nutrients in the food [26], therefore any health campaign that highlights the dangers of consuming oil that has been repeatedly heated should reach out to these groups of people.

CONCLUSION

In conclusion, the level of awareness of the general public in Kuala Lumpur regarding the usage of repeatedly heated cooking oil needs to be increased. More publicity and exposure about this little-known health issue should be given in the mass media. Awareness campaigns relating to this little-known health issue should be carried out by the relevant authorities. Field studies incorporating home visits should be done in order to truly evaluate the types of oils used and also to measure the actual level of toxic and polar compounds found in frying oils used in Malaysian home kitchens. A follow-up prospective cohort study is also warranted in order to observe whether there are any behavioural changes in the respondents surveyed regarding usage of repeatedly heated cooking oil. These measures might help improve the health status of not only Kuala Lumpur residents, but also of the general population throughout Malaysia as well.

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