

Usage of Repeatedly Heated Cooking Oil and Its Relationship to Knowledge and Practice among Nurses

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ABSTRAK

Kebanyakan rakyat Malaysia cenderung menggunakan semula minyak masak dalam masakan mereka, di mana ia menyumbang kepada banyak penyakit. Memandangkan jururawat adalah barisan hadapan dalam sektor kesihatan, pendidikan kesihatan sepatutnya diberikan kepada pesakit untuk meningkatkan kesedaran mereka tentang bahaya minyak masak yang dipanaskan berulang kali. Kajian ini bertujuan untuk mengkaji tahap pengetahuan dan amalan penggunaan minyak masak yang dipanaskan berulang kali dalam kalangan jururawat. Kajian keratan rentas telah dijalankan di kalangan 298 jururawat di Hospital Canselor Tuanku Muhriz pada Julai 2022. Jururawat telah melengkapkan soal selidik yang terdiri daripada faktor sosiodemografi, pengetahuan dan amalan penggunaan minyak masak yang dipanaskan berulang kali. Di kalangan 298 jururawat, 6.7% mempunyai tahap rendah, 44.0% mempunyai sederhana dan 49.3% mempunyai tahap pengetahuan yang tinggi mengenai minyak masak yang dipanaskan berulang kali. Tahap pendidikan responden dan kriteria pilihan minyak masak mempunyai perkaitan yang signifikan dengan tahap pengetahuan tentang penggunaan minyak masak yang dipanaskan berulang kali ($p < 0.05$). Sejumlah 52% jururawat mempunyai amalan baik manakala 48% mempunyai amalan buruk. Terdapat perkaitan yang signifikan antara pengetahuan dan amalan ($p < 0.001$). Walau bagaimanapun, tidak terdapat perkaitan yang signifikan antara pendapatan kasar isi rumah bulanan dengan kriteria pilihan minyak masak dan amalan penggunaan minyak masak yang dipanaskan berulang kali ($p > 0.05$). Pengetahuan yang tinggi tentang penggunaan minyak masak yang dipanaskan berulang kali adalah penting kerana ia menjejaskan amalan penggunaan minyak masak. Intervensi awal dan masakan rumah perlu digalakkan untuk mengurangkan peningkatan penyakit akibat penggunaan minyak masak yang dipanaskan berulang kali.

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Kata kunci: kesedaran, minyak sayuran, petugas kesihatan, sikap

ABSTRACT

Most Malaysians tend to reuse cooking oil in their cooking, which contributes to many diseases. Since nurses are frontliner in the health sector, health education can be given to patients and increase their awareness on the danger of repeatedly heated cooking oil. This study aimed to investigate the level of knowledge and practices regarding the usage of repeatedly heated cooking oil among nurses. A cross-sectional study was conducted among 298 nurses at Hospital Canselor Tuanku Muhriz in July 2022. The nurses completed a questionnaire consisting of sociodemographic factors, knowledge and practice of the usage of repeatedly heated cooking oil. Among 298 nurses, 6.7% had low, 44.0% had moderate and 49.3% had a high level of knowledge on repeatedly heated cooking oil. Respondents' education level and preferred criteria of cooking oil had significant association with level of knowledge on the usage of repeatedly heated cooking oil ($p < 0.05$). A total of 52% nurses with good practice while 48% had bad practice. There was significant association between knowledge and practices ($p < 0.001$). However, there was no significant association between monthly gross household income with preferred criteria of cooking oil and practices on usage of repeatedly heated cooking oil ($p > 0.05$). The high knowledge on usage of repeatedly heated cooking oil is important as it affects the practice of usage of cooking oil. Early intervention and home cooking should be encouraged to help in reducing the rising of diseases due to the use of repeatedly heated cooking oil.

Keywords: attitude, awareness, health care providers, vegetable oil

INTRODUCTION

Cooking oil is widely used in food preparation. Cooking oils are one of the rich source that contain vitamin E, with concentrations ranging from 15 to 49 mg a-tocopherol equivalents/100 g. When oxidation of unsaturated fatty acids during frying occurs, this causes vitamin E to be lost and significantly give impact on the amount of vitamin E being consumed in each meal intake (Md Sarip et al. 2021). Palm oil is the most widely used among

Malaysians. Palm oil is also known to be five times better withstand heated than soy oil (Negash et al. 2019). It has its own special components with 50% saturated and 50% unsaturated fatty acids that make them more stable compared to other vegetable oils (Aziz et al. 2018).

Deep-fried foods have always been popular as street food or home cooked food in Malaysia. The consumption of cooking oil as a medium of heat transfer in frying provides food with good taste, colour and aroma (Zhang et

al. 2020). Deep frying can be defined as a dry-heating cooking method that utilises fat or oil to cook pieces of food by completely submerging food in hot liquid. During the process of deep frying, the oil is exposed continuously or repeatedly to high temperatures (160-190°C) and causing a number of chemical reactions such as oxidation, polymerisation and hydrolysis in the oil (Kamisah et al. 2012). It is associated with the formation of 4-hydroxy-trans-2-nonenal (HNE) which is a highly toxic end product of lipid peroxidation (Ishak et al. 2016). The other byproducts of repeated heating of cooking oil include volatile compounds such as aldehyde, and ketone, polar compounds such as glycerol, non-polar compounds such as trans-fatty acids, and toxic compounds like acrylamide (Mohd Zahri et al. 2020).

When food is fried in previously used cooking oil, its nutritional composition may also be changed (Mohd Zahri et al. 2020). With concentrations range from 15 to 49 mg a-tocopherol equivalents/100 g, cooking oils are one of the rich sources of vitamin E. The amount of vitamin E consumed with each meal is dramatically impacted when unsaturated fatty acids undergo oxidation during frying, which results in vitamin E loss (Md Sarip et al. 2021), and oil spoilage (Jurid et al. 2020). Persistent consumption of the repeatedly heated cooking oil has been proven to cause hypertension and hypercholesterolemia, as well as vascular inflammation that predisposes to the risk of developing atherosclerosis (Ng et al. 2014).

Most of the cooks tend to keep the

used cooking oil after it is used once and is heated again for the next cooking. Despite having a good knowledge and education level on harmful effects of repeatedly heated cooking oil, it is a common practice to use the same cooking oil repeatedly to save the cost of living (Emelike et al. 2020). This was not a good practice as it could give harmful effects to health. Most of the studies that had been conducted are mainly among food outlet operators and vendors of night markets (Abdul Shukor & Rostam 2020; Aziz et al. 2018; Abdullah et al. 2015; Azman et al. 2012) who used cooking oil in large quantities for frying and selling the food. Due to lack of study being done previously among health care workers, we chose our respondents among nurses as they are only cooking dishes in small quantities for the families similar to the general population and also involved in managing and giving health education to patients.

To find out more about the understanding and habits of healthcare professionals regarding the use of repeatedly heated cooking oil, we conducted study specifically among them. Thus, we can know if they are really practising a good practice of using cooking oil or just having a good knowledge on the bad effects of using repeatedly heated cooking oil without practising it properly. This study would allow the front liners, especially nurses as one of the biggest contributors in helping the health sector to implement early interventions and preventive measures such as health education regarding the usage of repeatedly heated cooking oil especially to the

high-risk population who have been practicing to reuse cooking oil as main practice in daily life increasing the risk of life threatening non-communicable diseases. The findings of this study would help in reduction of our health burden on these diseases.

MATERIALS AND METHODS

This was a cross-sectional study looking at the knowledge and practice of using repeatedly heated cooking oil among nurses at Hospital Canselor Tuanku Mukhriz (HCTM) in Cheras, Kuala Lumpur, Malaysia. The study was approved by the UKM Research and Ethics Committee (FF-2022-176). It utilised purposive sampling involving nurses from various grades (U29 - U48) of HCTM. Nurses from all disciplines were invited to participate in this study. Nurses were chosen as our respondents because they were the forefront in patient education and management. Therefore, the general knowledge and practice about this issue was essential for them to instil awareness among the patients. The total population of nurses was 1319 (N=1319). The sample size required for this study (n=298) was calculated using the Krejcie & Morgan (1970) formula, which the sample size represented the total population of the study. Nurses on maternal or unpaid leave were excluded from the study.

Research Tools

This study was carried out using a self-reported, validated questionnaire. The questionnaire consisted of three parts. Part A comprised questions about

demographic factors such as age, ethnicity, level of education, monthly gross household income, the type of oil they used, their preferred criteria for choosing cooking oil in market, their reason of preference and the source of information from which they learned about the use of cooking oil.

Part B evaluated the respondents' level of knowledge on the use of repeatedly heated oil. This scale was developed by Abdullah et al. (2015). Questionnaire by Abdullah et al. (2015) has been validated and used by other studies (Aziz et al. 2018; Sivananthan et al. 2013; Abdul Shukor & Rostam 2020). The questionnaire had been modified and adapted to suit the study targeted respondents' style of cooking using oil. The modification involved changing the word frying to cooking to give an understanding of either nurses are also using repeated heated cooking oil in any type of cooking method, adding the preference choice of cooking oil and their reason for choosing the cooking oil based on their preference. Education level included none, primary and secondary were deleted as respondents of this study were nurses that must have education qualification of at least diploma levels in being certified nurses.

Part C was also based on Abdullah et al. (2015), measured respondents' practice regarding the usage of repeatedly heated cooking oil. In this part, the practice of HCTM nursing staff towards the usage of repeatedly heated cooking oil was reflected in their practice of using cooking oil. Among the questions asked were whether they used the repeated cooking oil

during cooking. If they were not using repeatedly heated cooking oil, they were asked using an open-ended question on the reasons for not using it and if they used repeatedly heated cooking oil during cooking, they were asked on how many times the oil was used before discarding it, how they attempted to preserve the oil's quality as if they use fresh oil for cooking every time they cook foods. The open-ended questions were analysed using content analysis. Pilot study was conducted prior data collection. The validity and reliability of the questionnaires were ($\alpha=0.64$) for knowledge of the usage of repeatedly heated cooking oil section, ($\alpha=0.71$) on practice regarding the usage of cooking oil. The reliability for the entire scale was $\alpha=0.75$.

Data Collection

The respondents in this study were approached by the researchers. Respondents who gave their consent were given a set of questionnaires. They could answer the questions at any convenient time and then were required to return the questionnaires in three days. The nurses sealed their completed questionnaires in the provided envelope and placed it in an identified locked box in the designated place.

Data Analysis

The data collected were tabulated and entered into IBM SPSS Statistics Software version 28.0 (Statistical Package for the Social Sciences, IBM Corp., Armonk, NY, USA). A

descriptive analysis was done where the calculation of frequency and mean was derived. Pearson correlation test was performed to determine the correlation between the age of nurses with the score of practice on the usage of repeatedly heated cooking oil. Mann-Whitney U test was used to find the association between (i) education level of nurses with score of practice on usage of repeatedly heated cooking oil and (ii) monthly gross household income with score of practice on usage of repeatedly heated cooking oil. Pearson chi-square test was used to determine the association between (i) type of cooking oil and monthly gross household income, (ii) preferred criteria of cooking oil and monthly gross household income, (iii) the level of knowledge and practice of using repeatedly heated cooking oil, (iv) education level and level of knowledge on the usage of repeatedly heated cooking oil and (v) preferred criteria of cooking oil with level of knowledge on the usage of repeatedly heated cooking oil. A p value of <0.05 was considered to be statistically significant.

RESULTS

Response Rate and Respondents' Sociodemographic Characteristics

A total of 298 nurses participated in the study (Table 1). The mean respondent age was 35.6 years ($SD=6.484$). Most of the respondents were female (91.6%), Malays (98.0%), diploma holders (88.3%). In terms of monthly gross household income, only 37.6% had monthly profits of more than

Table 1: Demographic characteristics of respondents (N=298)

Demographic	n (%)
Gender:	
Male	25 (8.4)
Female	273 (91.6)
Ethnicity:	
Malay	292 (98.0)
Indian	3 (1.0)
Others	3 (1.0)
Age:	
<25	13 (4.4)
25-29	42 (14.1)
30-34	85 (28.5)
35-39	63 (21.1)
40-44	71 (23.8)
45-49	21 (7.1)
50-54	3 (1.0)
Respondents' educational level:	
Diploma	263 (88.3)
Degree	33 (11.1)
Masters	2 (0.7)
Monthly gross household income (RM):	
<1000	2 (0.7)
1000-2999	57 (19.1)
3000-3999	61 (20.5)
4000-4999	66 (22.1)
>5000	112 (37.6)
Type of oil used for cooking:	
Palm oil	234 (78.5)
Peanut oil	2 (0.7)
Corn oil	19 (6.4)
Olive oil	30 (10.1)
Coconut oil	12 (4.0)
Others: Canola oil	1 (0.3)
Preferred criteria of cooking oil in market:	
Packet oil	85 (28.5)
Bottle cooking oil	164 (55.0)
Specific brand	49 (16.5)

RM5,000.00. For food preparation, most of them (78.5%) use palm oil, packed in a bottle (55%). Preference in cooking oil showed that good quality cooking oil that can be used few times, oil that was known to provide nutrition and good for health was the most preferred reason (45.0%) among the nurses. Internet was the most popular

source of information to obtained regarding usage of cooking oil (43.5%) (Table 2).

Knowledge of the Usage of Repeatedly Heated Cooking Oil

The use of frequently heated cooking oil (Table 3) was not deemed to be a good practice by more than half of the respondents (76.2%). The vast majority of respondents (88.9%) disputed that the quality of cooking oil stayed the same no matter how many times it was used for cooking. More than half of respondents (60.1%) also did not agree that cooking oil can be used again for cooking and should only be thrown out when it got black. Most of the respondents (85.2%) believed that the nutrients in the cooking oil would be lost over time when the cooking oil were frequently being heated. They also believed that type of by-products produced from repeatedly heated cooking oil was influenced by type of cooking oil (55.4%). Majority of them (91.3%) agreed that using repeatedly heated cooking oil was unhealthy and caused bad effects to health. Of

Table 2: Preference in cooking oil and source of information

Characteristics	n (%)
Reason for preference in cooking oil	
Price is cheaper	111 (22.7)
Easily to get and available in any store	158 (32.3)
Quality is good	220 (45.0)
Source of information	
Newspaper	73 (13.3)
Magazine	51 (9.3)
Internet	239 (43.5)
Family/Friend/Other people	180 (32.8)
No prior knowledge about this	6 (1.1)

Table 3: Respondents' knowledge of the usage of repeatedly heated cooking oil (N=298)

Knowledge of the usage of repeatedly heated cooking oil	Correct	Incorrect
	n (%)	
1. Usage of repeatedly heated cooking oil for cooking food is a good practice as it saves cost and there is no side effect.	227 (76.2)	71 (23.8)
2. The quality of oil used for cooking will remain the same regardless of how many times the oil is reheated.	265 (88.9)	33 (11.1)
3. We can use the oil many times and discard it only when it turns dark.	179 (60.1)	119 (39.9)
4. There will be loss of nutrients in the repeatedly heated cooking oil used for cooking.	254 (85.2)	44 (14.8)
5. The type of cooking oil does not influence the type of by-products produced from the repeatedly heated cooking oil.	165 (55.4)	133 (44.6)
6. Will repeatedly heated cooking oil used for cooking cause bad effects to our health?	272 (91.3)	26 (8.7)

those who agreed that eating heated repeatedly cooking oil was potentially harmful to one's health, 41.9% claimed that it can cause cancer and 40.6% claimed that it can cause hypertension. The mean score of knowledge was 5.13 (SD=1.483). Only 20 respondents (6.7%) had a low level of knowledge, 131 respondents (44.0%) had moderate level of knowledge and 147 of the respondents (49.3%) had high level of knowledge (Table 4).

Practice Regarding the Usage of Cooking Oil among Nurses of HCTM

More than half (Table 5) of respondents n=152 (51%) acknowledged that they frequently cook with repeatedly heated cooking oil. A total of 146 respondents

Table 4: Level of knowledge of the usage of repeatedly heated cooking oil

Level of knowledge	Frequency (%)
Low	20 (6.7)
Moderate	131 (44.0)
High	147 (49.3)

(49%) who did not frequently use cooking oil for cooking believed that this habit was hazardous and harmful to their health (n=94, 64.4%). Seven (4.79%) respondents stated other reasons for not repeatedly using heated cooking oil which included following family practice, being able to afford and buy new cooking oil and used cooking oil can be sold for income. Among 152 respondents who frequently used repeatedly heated cooking oil, more than half of them (n=94, 61.9%) claimed that they never reuse the oil more than twice, while only four respondents (2.6%) did for four times or more. There were a number of techniques that our respondents used to preserve the quality of cooking oil, including filtering the oil to remove any food particles or foreign objects and this method was the most common practice among the respondents (n=238, 79.9%).

Almost quarter (n=82, 27.5%) of the respondents scored 4 out of 5 regarding practice of the usage of repeatedly heated cooking oil. The mean score

Table 5: Practice regarding the usage of cooking oil

Practice of heated cooking oil usage	n (%)
1. Do you use repeated heated cooking oil during cooking?	
Yes	152 (51.0)
No	146 (49.0)
2. For the respondents who answered “No” to the above question 1, please state one reason for not using repeatedly heated cooking oil?	
a. Unhealthy and risks of getting diseases	94 (64.4)
b. Oil become low quality	23 (15.8)
c. Taste of food changed and becomes untasty	11 (7.5)
d. Use less quantity of cooking oil during cooking and frying	6 (4.1)
e. Rarely cooks	5 (3.4)
g. Others	7 (4.8)
3. For the respondents who answered “Yes” to the above question 1 and use the same cooking oil repeatedly for cooking, how many times is the cooking oil reused before discarded?	
2	94 (61.9)
3	54 (35.5)
4	4 (2.6)
4. Methods attempted in order to maintain the quality of cooking oil.	
a. Using fresh oil for cooking every time:	
Yes	221 (74.2)
No	53 (17.8)
Not sure	24 (8.1)
b. Maintaining small flame while cooking:	
Yes	131 (44.0)
No	116 (38.9)
Not sure	51 (17.1)
c. Using stainless steel cooking utensil:	
Yes	221 (74.2)
No	33 (11.1)
Not sure	44 (14.8)
d. Storing oil in stainless steel or glass container after usage:	
Yes	221 (74.2)
No	48 (16.1)
Not sure	29 (9.7)
e. Filtering the oil to catch any food particle or foreign matter:	
Yes	238 (79.9)
No	43 (14.4)
Not sure	17 (5.7)

of practice was 3.5 (SD=1.26). The findings showed that 155 respondents (52%) had good level of practice while 143 respondents (48%) had a bad level of practice. The practice regarding the usage of repeatedly heated cooking oil found no significant correlation with age, educational level, and monthly gross household income. The type

of cooking oil was divided into palm oil (n=234) and others (n=64) which consisted of peanut oil, corn oil, olive oil, coconut oil and canola oil. There was no significant association between the type of oil used for cooking and monthly gross household income among nurses of HCTM with $\chi^2=2.075$ and $p=0.15$. Preferred criteria of

cooking oil were divided into packet cooking oil (n=85) and others (n=213) which were bottle cooking oil and specific brands of cooking oil. There was no significant association between preferred cooking oil and monthly gross household income among nurses of HCTM with $\chi^2=0.609$ and $p=0.435$.

Table 6 showed that there was a significant association between knowledge and practice of the usage of repeatedly heated cooking oil among nurses of HCTM with $\chi^2=14.117$ and $p<0.001$. For the level of knowledge, this study found that there was a significant association between education level and level of knowledge on the usage of repeatedly heated cooking oil with $\chi^2=5.991$ and $p=0.05$. There was also a significant association between preferred criteria of cooking oil with level of knowledge on the usage of repeatedly heated cooking oil among nurses of HCTM with $\chi^2=8.234$ and $p=0.016$ (Table 7).

DISCUSSION

The findings of this study indicated that the type of cooking oil used by the majority of the nurses of HCTM

(78.5%) was palm oil. This was not an unforeseen finding because our country has been one of the main manufacturers in the palm oil industry globally for decades. Malaysia accounted for 25.8% and 34.3%, respectively, of the global production and exports of palm oil in 2020 (Malaysian Palm Oil Industry 2022). Not only that, palm oil's affordability and accessibility in Malaysia further contributed to its popularity as a cooking oil. This can be seen in a study by Er et al. (2020) where they found out that 14.4% of domestic consumers' satisfaction with palm oil were due to the price of palm oil being cheap and reasonable.

Besides, there were 10.1% of nurses who used olive oil for cooking at their respective homes. Olive oil is usually preferred due to its health benefits compared to other types of cooking oils despite its expensive price. Olive oil in cooking has shown multiple health benefits in terms of cardiovascular diseases, cancer and also age-related cognitive decline such as Alzheimer's (Robert & Richard 2019). Compared to previous studies such as Azman

Table 6: The relationship between knowledge and practice regarding the usage of repeatedly heated cooking oil

Variables	Practice regarding the usage of repeatedly heated cooking oil	
	χ^2 value	p-value
Level of knowledge on the usage of repeatedly heated cooking oil	14.117	<0.001

Test: Pearson-chi square

Table 7: The relationship between education level and preferred criteria of cooking oil with level of knowledge on the usage of repeatedly heated cooking oil

Variables	Level of knowledge on the usage of repeatedly heated cooking oil	
	χ^2 value	p-value
Education level	5.991	0.05
Preferred criteria of cooking oil	8.234	0.016

Test: Pearson-chi square

et al. (2012) and Abdul Shukor et al. (2020), 100% of the respondents who are food vendors in the night market used palm oil for cooking, and this differs from our study as food vendors opt for cheaper options to maximise profit than nutritious value compared to nurses who prepare food for their family at home. Other types of cooking oils such as soy oil, coconut oil and others are not populated for cooking among the nurses. This was similar to the findings in Abdullah et al. (2015) study, where the use of soy and corn oil were also not popular among their respondents.

Preferred criteria of cooking oils in the market chosen by nurses were divided into packet cooking oil, bottles and specific brand cooking oils. Majority of the nurses preferred bottle cooking oil (55.0%) compared to packet cooking oil (28.5%). The most preferred cooking oils can be explained by their reasons for preference of cooking oil where most of the respondents stated that it was easy to get and available in any store (32.3%), the quality was good (22.9%) and the price was cheaper (22.7%). Based on Norazura et al. (2021), most of the consumers believed that cooking oil packaged in pouches had poorer quality than cooking oil packaged in bottles as the prices are usually cheaper than the cooking oil in bottles. To correct the misperception between the quality of packet and bottle cooking oil, they conducted a study to determine the difference of quality between the two types of packaging by measuring a few characteristics such as free fatty acid (FFA), fatty acid composition, total

vitamin E and others. They found out that FFA, FAC (oleic acid), total vitamin E, colour (red, yellow, neutral and blue), polar compound and polymer compound of the commercial palm-based cooking oils sold in plastic pouches and PET bottles were not significantly different and statistically comparable. Therefore, the perception of consumers was inaccurate. This was also mentioned in the BERNAMA (2021) and Kosmo (2021) where the perception of cooking oil sold with subsidised price in packet per kilo was low in quality was wrong. The price was cheaper due to it was being controlled by the government and also aimed to reduce the burden on consumers to get cooking oil at a reasonable price. This concludes that the packet cooking oil is having the same quality as bottle cooking oil.

However, we found that there was significant association between preferred criteria of cooking oil in the market with level of knowledge on the usage of repeatedly heated cooking oil among nurses. This means that the level of knowledge can influence the criteria of choosing cooking oil. This had been shown that the nurses who were educated mostly chose other cooking oil which in bottle and specific brands of cooking oil as it was believed that packaging is more attractive with clear information on it. Our findings were similar to the findings in a study done by Chepkwony (2011) in Kenya, they also found out that there was a significant relationship between education level and attractiveness of the edible oil package. They also stated 1.03% of the consumer purchase decisions of

edible oil were explained by education level. With every increase in one unit of education level, the importance of price of the product, the label of the product, and quality of the product decreased while the attraction of the label increased (Chepkwony 2011).

Based on the findings in Er et al. (2020), they found out that the price was not only the reason for domestic consumer satisfaction for preference of cooking oil but also depending on the quality and brands. They found that the brands of cooking oil, 'Buruh' was being the top choice of domestic users even though the price was RM22.95 for 5 kg per bottle compared to others such as 'Sri Murni' (RM16.99), Alif (RM21.99), Saji (RM22.69), Vesawit (RM22.39), Neptune (RM24.90) and Helang (RM26.99). From study by Setiawan (2021) in Indonesia, customers also anticipated that branded cooking oils would be of higher quality than non-branded cooking oils and will be able to back up all the promises made in the promotion and packaging. These findings explained the reason why we had respondents that chose specific brands of cooking oil (16.4%) as their preferred criteria of cooking oil in the market.

In the present study, the majority of the nurses (49.3%) had high level of knowledge on the usage of repeatedly heated cooking oil. Another 131 respondents (44.0%) had moderate level of knowledge and there were only 20 respondents (6.7%) who had low level of knowledge. This could be due to the fact that the nurses were well educated and based on our research result, the majority of

the nurses (88.3%) had completed their diploma studies. Compared to the study by Abdul Shukor and Rostam (2020), the majority of the food handlers in their research had a moderate level of knowledge on repeatedly heated cooking oil as most of them had education up to school level only. Based on the results, there was a significant association between education level and level of knowledge on the usage of repeatedly heated cooking oil among nurses of HCTM. This was concordance with Azman et al. (2012) study where highly educated respondents had significantly more awareness concerning the usage of repeatedly heating cooking oil if compared to less educated respondents. Comparing the study from Aziz et al. (2018), most of the respondents were not aware of the harmful substances detected in cooking oil mainly in repeatedly heated cooking oil which can be explained based on the respondents' educational level where most of them completed their higher studies in secondary school.

Besides that, there are 25.99 million Internet users in Malaysia, and a large number of nurses (43.5%) had claimed their source of information regarding the usage of reheated oil is through the internet. This widely accessed internet in our country has contributed to increasing knowledge among the users of the internet throughout our country. Based on the results we obtained, there were 1.1% of the nurses who had never gotten any prior knowledge about this issue from any sources, hence this might be the root cause of

the low level of knowledge on usage of repeatedly heated cooking oil among the nurses of HCTM. According to Abdullah et al. (2015), the degree of information among urban residents of Kuala Lumpur regarding this little-known health issue might be viewed as being typical knowledge among an urban population of a developing country in South-East Asia. As in our study, the nurses were working in a hospital located in Kuala Lumpur and they were well versed with health issues which showed high level of knowledge among them. Also, based on the study by Abdullah et al. (2015) there is a high level of awareness among the night market food operators in Kuala Lumpur that consumption of repeatedly heated cooking oil is not healthy and our research also shows a similarity of the nurses having a high level of knowledge on this issue.

In terms of the practice of using repeatedly heated cooking oil, 51% of respondents used repeatedly heated cooking oil for cooking. More than half of the respondents (61.84%) said they never use the same cooking oil more than twice before discarding the oil and only 4% of them claimed to reuse the oil more than four times. This practice is not detrimental as most of the respondents use palm oil for cooking and palm oil has been proven to withstand thermal oxidation better compared to other types of cooking oils (Shuid et al. 2007). Palm oil was known to be five times better withstand being heated than soy oil (Shuid et al. 2007). It has its own special components with 50% saturated and 50% unsaturated fatty acids that make

them more stable compared to other vegetable oils (Aziz et al. 2018).

Another 74.2% of our respondents used fresh oil each time for cooking. They were aware that repeatedly heated cooking oil was unhealthy, prone to risks of getting diseases and also leads to low quality of oil. When cooking oil is reused continuously for frying purposes, there will be a change in their physical and chemical properties. It is associated with the formation of 4-hydroxy-trans-2-nonenal (HNE) which is a highly toxic end product of lipid peroxidation (Ishak et al. 2016). The other byproducts of repeated heating of cooking oil include volatile compounds such as aldehyde, and ketone, polar compounds such as glycerol, non-polar compounds such as trans-fatty acids, and toxic compounds like acrylamide (Mohd Zahri et al. 2020). These byproducts were formed as a result of several heating-induced reactions of the cooking oil, including hydrolysis, oxidation, cyclisation, isomerisation, and polymerisation and these products will cause oxidative stress and accelerated lipid degradation (Mohd Zahri et al. 2020). According to Kabir (2014), reusing the waste cooking oil continuously can increase the risk of cardiovascular diseases, liver problems and cancer.

A total of 44% of our respondents claim to maintain a small flame during cooking to preserve the quality of cooking oil. This is a good practice as cooking oil when exposed to high temperatures (160-190°C) leads to formation of oxidative products that are unhealthy (Kamisah et al. 2012). Besides, 74.2% respondents used

stainless steel utensils to preserve the cooking oil quality, which also is a good application as they are able to withstand high cooking temperature and does not release heavy metals into the oil and meals (Berger 2005). According to our score system based on materials and methodology, the majority of respondents (52%) had good practice with the majority of respondents scoring 4 out of 5, with a mean score of 3.5.

In terms of the sociodemographic data and practice of usage of cooking oil, there was no significant association between education level and score of practice regarding the usage of repeatedly heated cooking oil among nurses of HCTM. This explained that the good practices were not influenced by education level even though they were aware about the deleterious health effects such as cancer upon long-term consumption of oil being repeatedly heated.

For monthly gross household income, we found out there was no significant association between income and score of practice regarding to the usage of repeatedly heated cooking oil among nurses of HCTM. This is similar to previous studies by Azman et al. (2012) and Abdul Shukor and Rostam (2020) which found that practice regarding the usage of repeatedly heated cooking oil is not influenced by their monthly income. This result could be explained by Sivananthan et al. (2013) which stated either in the commercial sector or in the household pattern, using the same frying oil repeatedly has become a common practice, mostly to save money or

reduce the cost of making a product available for consumption.

One important finding that we concluded from this study was that there was a significant association between knowledge and practice of the usage of repeatedly heated cooking oil among nurses of HCTM. Because they were more aware of the detrimental effects of consuming repeatedly heated cooking oil, we can thus expect that people with adequate knowledge about this issue would have good practice in the utilisation of cooking oil. Previous studies Abdulllah et al. (2015) and Abdul Shukor and Rostam (2020) showed that there was no significant association between knowledge and practice regarding the usage of repeatedly heated cooking oil among food vendors. This was contrary to our findings. The main reason for this discrepancy is due to the target consumer and purpose for cooking of both populations.

Nurses preparing food at home for their family take health into consideration more compared to our local food vendors who sell food to the public for profit. According to Mills et al. (2017), home cooks were more interested in prospective nutritional advantages. This can be the reason despite having good or poor knowledge about repeatedly heated cooking oil, it does not affect the practice regarding the same issue among food vendors. The study by Abdul Shukor and Rostam (2020) revealed that the level of knowledge on usage of repeatedly heated cooking oil in respondents with lower education was higher compared to higher educated respondents. This

was believed due to early involvement of the respondents in food handling service and having knowledge from those who have more experience in this field for years. However, even though they had a good knowledge on the bad effects of using repeatedly heated cooking oil, their practice remained in a way that could lead to harmful effects on health.

Knowledge is very important in determining practices on the usage of repeatedly heated cooking oil. The level of knowledge regarding the quality of oils needs to be improved such as frequency of using, changing the oil and frying practices as these will contribute to the practice in using cooking oil for food preparation. A study was conducted by Emelike et al. in 2020 which involved 15 respondents of local fried food vendors in Rivers State, Nigeria to examine the level of knowledge and practice among local fried food vendors regarding to the quality of oils used for frying. This study showed that the level of knowledge was reflected in the practice of using cooking oil. This was shown by the practice of their respondents that they had poor knowledge on the frequency of changing cooking oil with the majority of the respondents (46.67%) changed their oils over a week, only 20% of respondents changed their oil every other day while the rest changed their used oil every week. The other bad practice among the local food vendors in this study is the frequency of re-using the oil. The bad practice however was not limited to the food vendors only. Hasianta and Nasrullah (2019) found a significant relationship

between knowledge and behavior with repeated heating cooking oil practice among housewives. They were found to use repeatedly heated cooking oil in their cooking, thus also supporting that knowledge and awareness play significant role in influencing the housewives' role.

To increase the knowledge regarding the harmful effects of using repeatedly heated cooking oil, an urgent initiative must be done to equip all groups of people with sufficient information on the proper way to use cooking oil. An education on frying or cooking with safe practices is very important to raise the knowledge on the usage of cooking oil in all people as most of the food that we consume nowadays contains oils.

There were some limitations to this study with regards to the socio demographic of the where majority of the respondents were female (91.6%) and Malay (98%). If more respondents were identified, the data would be more diversified and would have been more concrete. The respondent's lifestyle and medical history such as diabetes and hypertension were not taken into consideration and may be important determinants with regards to the practice of repeatedly heated cooking oil.

CONCLUSION

The level of knowledge of nurses in HCTM were good. Level of knowledge on the usage of repeatedly heated cooking oil were significantly related showing the nurses were knowledgeable and relevant to give

health education regarding usage of repeated heated cooking oil. Nurses in this study cooked for their own family. Compared to findings from previous studies among street market food outlet operators, it shows that home cook was healthier compared to massive street food. This is important for the prevention of numerous non-communicable diseases such as cardiovascular diseases and cancers as nurses are the pilots in patient education. We believed this study set baseline data that can lead to the formation and implementation of interventions and training programs among health care workers to ensure better patient education.

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