ORIGINAL ARTICLE

RELATIONSHIP OF SOCIO-DEMOGRAPHIC CHARACTERISTICS, NUTRITIONAL STATUS, AND RED MEAT INTAKE TO BLOOD CHOLESTEROL LEVEL AMONG STAFF IN UNIVERSITI SAINS MALAYSIA

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ABSTRACT

The main objective of the study was to determine the factors associated with blood cholesterol level among staff in Universiti Sains Malaysia (USM). The study was a cross-sectional. One-hundred staff between 23 and 59 years of age were recruited in this study using convenient sampling at USM Health Campus. A questionnaire which includes socio-demographic characteristics, medical history, and red meat intake was used in the study. Anthropometric and biochemical assessment were measured. Blood cholesterol level was divided into two categories which were known as healthy range (<5.2mmol/L) and slight risk/high risk range (≥5.2mmol/L). The gender distribution of respondents for this study comprised of 40 male and 60 female. The age group (18 to 39) years and (40 to 59) years had a total of 40.3% and 63.2% of slightly risk or high risk blood cholesterol respectively; with the significant association between age group and blood cholesterol level (x^2=4.916,p=0.027). Besides, normal BMI group had 66.7% of respondents achieved healthy blood cholesterol level whereas underweight, overweight and obese group had 39.7% achieved healthy blood cholesterol with the significant association between BMI and blood cholesterol level (x^2=7.112,p=0.008). Moreover, daily or weekly intake of red meat showed that 65.0% of total respondents had a healthier blood cholesterol level compared to 51.0% of monthly, rarely, or none red meat intake group which achieved healthy blood cholesterol level. The result also showed a significant association between red meat intake and blood cholesterol (x^2=5.229, p=0.022), which indicating less red meat consumption is linked to high level of blood cholesterol level. Therefore, further investigation and future studies are needed to gain a clearer understanding of the association between these variables and blood cholesterol level.

***Keywords**: nutritional status, blood cholesterol level, red meat intake*

INTRODUCTION

Cardiovascular disease is a leading cause of mortality and morbidity in developed and developing countries including Malaysia.[1] Incidence of atherosclerosis was associated with high level of serum cholesterol and saturated fat intake in previous literature. Saturated fatty acids (SFA) increase low-density lipoprotein (LDL) cholesterol levels in the plasma and thus increase cardiovascular disease risk while polyunsaturated fatty acids (PUFA) decrease LDL cholesterols.[2] Individuals who consumes more meat have been found to have higher intakes of dietary cholesterol and low-density lipoprotein cholesterol and triglycerides than vegetarians, vegans or individuals with moderate or low meat consumption.[3]

It is well known that different fatty acids have different effects on blood cholesterol levels, some beneficial and some adverse (ref.). Therefore, it is important to consider the fatty acid profile of a food as a control measure for one's diet. The main SFAs that present in red meat are palmitic acid and stearic acid. Myristic acid which is thought to increase blood cholesterol level more potently than palmatic acid is present in small minute amount in red meat. The stearic acid appears to have no effect on blood cholesterol level although it is one of the SFAs.

Meat contains small amount of long chain omega 3 poly-unsaturated fatty acids (PUFAs) such as eicosapentaenoic acid (EPA), docosapentaenoic acid (DPA) and docosahexanenoic acid (DHA). In a few studies, PUFAs shown potential benefits in relation to cardiovascular health especially in those who had suffered a heart attack.[4] The fat content of meat can be modified through preparation and cooking methods. Consumer can reduce the amount of fat by trimming the fat off meat. Besides, grilling or dry-frying can result in fat losses compared to those meat sitting in the fat

used for frying or deep frying which will increase the fat content from meat product.[5]

Vegetarian diet includes legumes, soy product, nuts and vegetables; and provides protective effect against cardiovascular disease. Previous laboratory studies have shown that different types of fatty acids in diet have influence different on blood cholesterol and LDL-cholesterol level was lowered when some SFAs were replaced by monounsatured fat (MUFA)s, PUFAs and carbohydrate.[4] Some cohort studies have shown an association between high meat intake and increased in cardiovascular disease risk but most of these studies had combined meat intake from all sources and the different types of meat have not been distinguished. Nonetheless, dietary fats have been positively associated with blood cholesterol levels which being regarded as an important influence on cardiovascular disease.[4]

The desirable total cholesterol level is less than 5.2mmol/L (reference). According to National Health and Morbidity Survey conducted by Institute of Public Health in year 2011, 6.2 million of adults (35.1%) aged 18 years and above have hypercholesterolemia . From that, 8.4% were diagnosed with hypercholesterolemia whilst 26.6% were previously undiagnosed hypercholesterolemia.[6] The prevalence of hypercholesterolemia in Kelantan was higher than the national prevalence (ref). A population based cross sectional study in Kelantan was conducted in 2006 among 1946 subjects aged 18 years and above reported that, the prevalence of hypercholesterolemia was significantly lower in the urban area compared to rural areas. The mean total cholesterol level was 4.81mmol/L (186.0 mg/dl).[7] The aim of this study was to determine the consumption of the red meat associated with blood cholesterol level.

METHODOLOGY

This study was a cross-sectional study designed to identify factors associated with blood cholesterol level among staff at Health Campus, Universiti Sains Malaysia. The data collection was conducted in March 2015. All respondents were recruited from USM Health Campus, Kelantan. The School of Health Sciences, School of Dental Sciences and School of Medical Sciences were chosen as the research settings. Respondents who fulfilled the inclusion criteria were listed and convenient sampling was used to recruit the respondents. Permission to conduct this study were sent to Dean's office of 3 schools. Ethics approval was obtained from the Human Research Ethics Committee USM (USM/JEPeM/14110453). The study

subjects were given both oral and written explanation subject's information sheet explanation. Consent was obtained from each subject prior enrollment into the study.

All respondents were interviewed by a group of researchers using a pre-tested structured questionnaire. The data collection was conducted in Malay language. Information obtained included socio-demographic background (age, gender, ethnicity, religion, siblings' number, household monthly income, and education level), medical history (type of medical problem). A food frequency questionnaire (FFQ) was used to assess the diet quality of the respondent. In this study, the FFQ used consists of a 126 structured listing of individual foods or food groupings. The FFQ seeks information on consumption namely food groups, reference portion, subject's serving size, and number of item eaten per day, per week, per month, per year, or never. However, only meat and meat products will be the focus in this study include unprocessed and unpreserved meat from beef, lamb, and pork. Weight was measured by the SECA Dual weighing scale (SECA-762) and height of the subjects was measured by using a SECA body meter (SECA-206) to nearest 0.1cm. Weight and height of the respondents were then used to calculate BMI (reference). Blood cholesterol level was measured by Cardiochek PA Lipid Analyzer were then divided into two category i.e. normal (value) and slightly high (value). Cholesterol levels are measured in millimoles of cholesterol per liter of blood. Blood pressure level was measured by the OMRON HEM-7120. The blood pressure level were categorized by CPG (2013).

Data was analyzed by using SPSS, version 22.0. Description data including mean, standard deviation, frequency, percentage, minimum, and maximum were obtained. Mean differences of socio-demographic status, medical history, food intake, anthropometry indicators (BMI), blood cholesterol level, and blood pressure level between males and females were analyzed by using Independent-Samples T-test. The association of socio-demographic, medical history, food intake, anthropometry indicators (BMI), and blood pressure level with blood cholesterol level were determined by using Chi-square test. The level of probability, $p<0.05$ was used to show the level of significance for all the tests.

RESULTS

A total of 100 respondents were recruited from the 3 schools of Health Campus Universiti Sains Malaysia with a response rate of 81.3%. The socio demographic characteristics by gender were presented in Table 1. Respondents were 40.0 (?%) males and 60.0 (?%) females. The age range for respondents was between 23 years to 59 years. The median age of respondents was 35.0 years old. The mean age of subjects was 37.5 ± 9.3 years with the males having slightly higher (38.9 ± 9.1 years) mean age than the females (36.5 ±9.3 years). Meanwhile, majority of the staff (68%) had achieved diploma or university education. Furthermore, the majority gross household monthly income for the respondents were above RM3000 (63.0%), followed by 20.0% have monthly income RM2001-RM3000, 16.0% have monthly income RM1001 to RM2000 and 1.0% have monthly income less than RM1000. On the other hand, n (60.0%) of male respondents showing a slightly higher percentage for no medical history compared with n (41.7%) of female respondents had no medical history.

Table 1: Distribution of respondents by gender according to socio-demographic characteristics

Socio-demographic Characteristic	Male (n=40)	Female (n=60)	Total (n=100)	p-value [a]
Age (Years) (Mean ± SD)	38.9 ± 9.1	36.5 ± 9.3	37.5 ± 9.3	[a] (1.253, 0.213)
Age Range, n(%)				
18-29	6 (15)	13 (21.7)	19 (19.0)	
30-39	17 (42.5)	26 (43.3)	43 (43.0)	
40-49	11 (27.5)	13 (21.7)	24 (24.0)	
50-59	6 (15)	8 (13.3)	14 (14.0)	
Ethnicity				
Malay	38 (95)	59 (98.3)	97 (97.0)	
Chinese	1 (2.5)	1 (1.7)	2 (2.0)	
Indian	1 (2.5)	0 (0)	1 (1.0)	
Educational level				
PMR	1 (2.5)	0 (0)	1 (1.0)	
SPM	17 (42.5)	14 (23.3)	31 (31.0)	
Diploma/University	22 (55.0)	46 (76.7)	68 (68.0)	
Income Level (RM)				
<1000	0 (0)	1 (1.7)	1 (1.0)	
1001-2000	8 (20.0)	8 (13.3)	16 (16.0)	
2001-3000	8 (20.0)	12 (20.0)	20 (20.0)	
>3000	24 (60.0)	39 (65.0)	63 (63.0)	

Data were presented as mean ± SD or frequency (percentage) or median (IQR)
Statistical test was computed using t-test
[a]Comparison between gender according to t-test

Overall the mean weight was 66.0 ± 13.4kg. The body weight for male respondents was (74.2 ± 11.8kg) and female respondents was (60.6 ± 11.6kg). On the other hand, the overall mean height was 160.3 ± 8.5cm, male respondents (167.9 ± 5.9cm) which was higher than female respondents (155.2 ± 5.8cm). The mean BMI was slightly higher among male respondents (26.4 ± 4.5kg/m^2) than female respondents (25.1 ± 4.5kg/m^2) (Table 2). The mean systolic blood pressure was 117.9±15.8 mmHg. A number of 51.0% total respondents where 13 (32.5%) male respondents and 38 (63.3% female respondents had normal blood pressure (Table 3).

Table 2: Distribution of respondents by gender according to BMI

BMI	Male (n=40)	Female (n=60)	Total (n=100)	p-value [a,b]
Weight(kg) (mean ± SD)	74.2 ± 11.8	60.6 ± 11.6	66.0 ± 13.4	[a](5.719, <0.001)*
Range			36.0 – 98.0	
Height(cm) (mean ± SD)	167.9 ± 5.9	155.2 ± 5.8	160.3 ± 8.5	[a](10.624, <0.001)*
Range			141.0 – 178.2	
BMI(kg/m^2) (mean ± SD)	26.4 ± 4.5	25.1 ± 4.5	25.6 ±4.5	[a](1.391, 0.167) [b](1.341, 0.247)
Range			16.4 – 37.3	
[c]**BMI category**				
Underweight, n(%)	1 (2.5)	2 (3.3)	3 (3.0)	
Normal, n(%)	14 (35.0)	28 (46.7)	42 (42.0)	
Overweight,n(%)	16 (40.0)	20 (33.3)	36 (36.0)	
Obese, n(%)	9 (22.5)	10 (16.7)	19 (19.0)	

[a]Comparison between gender according to T-test
[b]Chi-square test
**Significant at p<0.05 (2-tailed)*
[c]BMI category: Underweight(<18.9kg/m^2), Normal(18.9-24.9kg/m^2), Overweight(24.9-29.9kg/m^2), Obese(>30kg/m^2)

Table 3: Distribution of respondents by gender according to blood pressure level

Blood Pressure	Male (n=40)	Female (n=60)	Total (n=100)	p-value [a,b]
Systolic (mmHg)	124.1 ± 13.4	113.8 ± 16.0	117.9 ±15.8	[a](3.355, 0.001)*
Range			82 - 159	[b](9.130, 0.003)*
Diastolic(mmHg)	80.1 ± 10.1	74.7 ± 9.6	76.9 ± 10.1	[a](0.719, 0.009)*
Range			52 - 100	
[c]**Blood Pressure Classification**				
Hypotension	0 (0)	1 (1.7)	1 (1.0)	
Desired	13 (32.5)	38 (63.3)	51 (51.0)	
Prehypertension	21 (52.5)	19 (31.7)	40 (40.0)	
Hypertension	6 (15.0)	2 (3.3)	8 (8.0)	
Family History				
Yes	22 (55.0)	29 (48.3)	51 (51.0)	[b](0.427, 0.514)
No	18 (45.0)	31 (51.7)	49 (49.0)	

[a]Comparison between gender according to t-test, [b]Comparison between gender according to Chi-square test
**Significant at p <0.05 (2-tailed), [c]Blood Pressure Classification adapted from National Heart, Lung, and Blood Institute*

Findings showed that only 5.0% of respondents took red meat daily where 4 (10.0%) of male respondents and 1 (1.7%) of female respondents). However, 35.0% and 46.0% of total respondents took red meat weekly and monthly, respectively. Meanwhile, a total of 11.0% of total respondents and 3.0% of total respondents ate meat rarely or do not take red meat at all (Table 4). The mean blood cholesterol level was 5.28±1.1mmol/L where male respondents were 5.25±1.2mmol/L and female respondents were 5.29±1.0mmol/L. Result showed that 51.0% of respondent where 20 (50.0%) male respondents and 31 (51.7%) female respondents were able to achieve desired target of blood cholesterol level below 5.2mmol/L (Table 5). Another studies showed that for each 100 g per day increment in red meat consumption had rising the risk of stroke by 13% . While meta-analysis study found that 15% for red and processed meat, 9% for red meat and 14% for processed meat consumption increased drastically the risk of stroke respectively . And the significant correlation for stoke subtypes was ischemic stroke but not for hemorrhagic stroke.[26]

Table 4: Distribution of respondents by gender according to red meat consumption

Food intake	Male (n=40)	Female (n=60)	Total (n=100)
Red Meat Intake, n(%)			
Daily	4 (10.0)	1 (1.7)	5 (5.0)
Weekly	18 (45.0)	17 (28.3)	35 (35.0)
Monthly	12 (30.0)	34 (56.7)	46 (46.0)
Rare	5 (12.5)	6 (10.0)	11 (11.0)
Never	1 (2.5)	2 (3.3)	3 (3.0)

Table 5: Distribution of respondents by gender according to cholesterol level

Cholesterol Level	Male (n=40)	Female (n=60)	Total (n=100)	p-value [a,b]
Mean	5.25 ± 1.2	5.29 ± 1.0	5.28 ± 1.1	[a] (-0.191, 0.849)
Range			3.01 – 9.49	[b] (0.027, 0.870)
Blood Cholesterol level				
Desired (<5.2mmol/L)				
Slightly Risk (5.2-6.2mmol/L)	20 (50.0)	31 (51.7)	51 (51.0)	
High Risk (>6.2mmol/L)	13 (32.5)	17 (28.3)	30 (30.0)	
	7 (17.5)	12 (20.0)	19 (19.0)	
Familial Hypercholesterolemia				
Yes	14 (35.0)	22 (36.7)	36 (36.0)	[a](1.768, 0.082)
No	26 (65.0)	38 (63.3)	64 (64.0)	[b](3.643, 0.056)

[a]Comparison between gender according to t-test
[b]Chi-square test

Variables which had significant association with blood cholesterol level ($p<0.05$) include age group, BMI, blood pressure level and food intake. On the other hand, variables such as educational level, income level, family history of cholesterol, and medical history had no significant association with blood cholesterol level. Thirthy seven (59.7%) of respondent in age group 18 -39 years had a healthy blood cholesterol and 24 (63.2%) age group 40-59 had of slightly risk or high risk blood cholesterol with the significant association between age group and blood cholesterol level ($x^2=4.916$, $p=0.027$). Besides, 28 (66.7%) of respondents in normal BMI group had achieved healthy blood cholesterol level whereas 35 (60.3%) underweight, overweight and obese group had achieved slightly risk or high risk blood cholesterol with the significant association between BMI and blood cholesterol level ($x^2=7.112$, $p=0.008$). Furthermore, 60.8% of respondents in normal blood pressure group had achieved healthy blood cholesterol whereas 29 (59.2%) of respondents from hypotension, pre-hypertension and hypertension group had slightly risk or high risk blood cholesterol level with a significant association between blood pressure level and blood cholesterol level ($x^2=3.987$, $p=0.046$). in contrary, there were significant association between red meat intake and blood cholesterol ($x^2=5.229$, $p=0.022$), indicating increase of red meat consumption is linked to better blood cholesterol level(Table 6).

DISCUSSION

The prevalence of high blood cholesterol increases with increasing BMI especially among overweight and obese men, however it is higher among women in normal weight.[8] Hypercholesterolemia is frequently found in obese individuals and the average serum cholesterol is significantly higher in overweight respondents than in normal BMI. Obesity is significantly correlated with serum cholestero1. Obesity is a potent factor in enhancing cholesterol synthesis and a very important etiological factor in hypercholesterolemia because of high frequency of obesity in modern society. In this study, we found that BMI has a significant association with blood cholesterol level; overweight and obese group had a slightly elevated or high elevated blood cholesterol level. A previous study showed that there was a significant association between the total body cholesterol synthesis and both excess body weight and adipose cellularity.[9]

Table 6: Association between socio-demographic characteristics, medical history, anthropometry indicators (BMI), biochemical indicators (blood pressure level), and red meat intake with blood cholesterol level

Variable	Blood Cholesterol Level		Total (n=100)	p-value [a]
	Healthy (n=51)	Slightly Risk/High Risk (n=49)		
Age Group				
18-39	37 (59.7)	25 (40.3)	62 (62.0)	[a](4.916, 0.027)*
40-59	14 (36.8)	24 (63.2)	38 (38.0)	
Education level				
PMR/SPM	15 (46.9)	17 (53.1)	32 (32.0)	[a](0.320, 0.571)
Diploma/University	36 (52.9)	32 (47.1)	68 (68.0)	
Income level (RM)				
<3000	18 (48.6)	19 (51.4)	37 (37.0)	[a](0.130, 0.718)
≥3000	33 (52.4)	30 (47.6)	63 (63.0)	
Familial Hypercholesterolemia				
Family History	19 (52.8)	17 (47.2)	36 (36.0)	[a](0.071, 0.790)
No Family History	32 (50.0)	32 (50.0)	64 (64.0)	
Medical History				
None	25 (51.0)	24 (49.0)	49 (49.0)	[a](0.000,0.997)
Other Diseases	26 (51.0)	25 (49.0)	51 (51.0)	
BMI				
Normal	28 (66.7)	14 (33.3)	42 (42.0)	[a](7.112, 0.008)*
Underweight, Overweight & Obese	23 (39.7)	35(60.3)	58 (58.0)	
Blood Pressure				
Normal	31 (60.8)	20 (39.2)	51 (51.0)	[a](3.987, 0.046)*
Hypotension, Prehypertension & Hypertension	20 (40.8)	29 (59.2)	49 (49.0)	
Red Meat Intake (Frequency)				[a](5.229, 0.022)*
Daily/Weekly	26 (65.0)	14 (35.0)	40 (40.0)	
Monthly/Rare/ None	25 (51.0)	35 (49.0)	60 (60.0)	

*[a]Comparison between socio-demographic characteristics, medical history, anthropometry indicators (BMI), biochemical indicators (blood pressure level), and red meat intake with blood cholesterol level according to T-test, *Significant at p<0.05 (2-tailed)*

A part of that, an increased sugar intake was associated with weight gain by Monyo et al [12]. Kelantan is well known for its population incline towards sweet food and drinks.[10] According to NHMS (2015), Kelantan ranked the third highest state for the prevalence of overall diabetes (18.5%) in Malaysia.[11] In addition, sugar consumption is one of the significant predictors of obesity in a multivariate regression model.[13] It is recommended that daily sugar intake should be reduced to less than 5% of total energy intake (around 6 level teaspoons) for a person with healthy weight with approximately 2000 calories per day,[14] and opts for water, unsweetened coffee or tea rather than high calorie sweetened beverages.[15]

Besides, there is a change in the metabolism of cholesterol as age increase. Based on this study there were significant associated between age group and blood cholesterol level (Table 6.0) and it is inclined with the study that showed an

increment of serum and total LDL-cholesterol concentrations with age by 40% from age 20-60 years.[16] It is known that normal aging process for both humans and rodents increases the plasma levels in total and LDL-cholesterol level. On the other hand, there is a decrease in plasma clearance of LDL with the increase in age for human and rodents. Another study stated that aging per se increased biliary cholesterol hypersecretion and intestinal cholesterol absorption significantly, and diminished activity of cholesterol 7α-hydroxyase, which indicated a reduced metabolism of cholesterol to bile salts.[17] Aging influenced the process of cholesterol metabolism as a study showed that there was a decline in the rate of synthesis and catabolism of cholesterol in adult rat livers with the evidence of reduced HMG-CoA reductase activity and no increase in cholesterol 7α-hydroxylase activity. This study also found that there was a decline in both of trh enzymes HMG-CoA synthase and acetoacetyl-CoA synthetase, which were the substrate for the key enzyme HMG-CoA reductase.[18] Growth hormone plays an important role in cholesterol metabolism.[19] The possible reason of age-related decline in growth hormone level is the reduction on hypothalamic secretion of growth hormone-releasing hormone (GHRH) with consequence reduced of growth hormone biosynthesis and release by the anterior pituitary. Increased adiposity is one of the symptoms of adult growth hormone deficiency.[20]

From a previous study, it reported that greater consumption of unprocessed and processed red meats was associated with higher mortality risk as compared with other dietary components such as fish, poultry, nuts, legumes, low fat dairy products and whole grains.[21] Individuals with high consumption of red meat have been found to possess both higher intakes of cholesterol and higher plasma concentrations of total cholesterol and LDL- cholesterol and triglycerides than vegetarians, vegans and moderate and low consumers of meat.[3] A high intake of cholesterol from red meat has been shown to raise blood total and LDL-cholesterol concentrations and thus increase the risk of stroke.[22] Chen et al found that individuals with highest intakes of red meat and processed meat had notably increased the risk of total stroke compared to individuals who not taken red meat.[26]

However, in this study, respondents who consume red meat daily and weekly seems to have healthier cholesterol level. The result is in contrary to the previous study. This may be due to their dietary pattern and the preparation or cooking method of red meat. On the other hand, the percentage of slightly or high risk of cholesterol level (49%) was similar to the percentage of healthy cholesterol (51%) among the respondent with less red meat intake (Table 6.0). This might be due to consumption of other food sources rich in saturated fats and trans fats (TFA). The food groups rich in TFA in Malaysia include semisolid fats and cooking oil, fast foods, fried foods, and selected baked products. Examples of fried foods such as banana fritters, fried yam*, keropok lekor*, chicken and cuttlefish balls are commonly available in night market and street hawkers. These fried foods as well as fast foods are normally fried cooking oil that usually repeatedly used. The repeatedly used of cooking oil in deep frying of food is associated with total TFA of subjects in the study.[23] Trans fatty acids increase the ratio of LDL-cholesterol to HDL-cholesterol.[24] A meta-analysis of 12 randomized control trials stated that TFA increased LDL cholesterol (atherogenic), decreased HDL cholesterol (anti-atherogenic), and raised ratio of total cholesterol: HDL cholesterol, which is a powerful predictor of CHD risk.[25]

LIMITATIONS

This study only included respondents in USM Kota Bharu, Kelantan which limit the generalization of the findings to other population. Therefore, future study is recommended to use a larger sample size as to give a better picture of health status among Malaysia population.

CONCLUSION

In this study, there were an association between the age group, BMI, blood pressure level and red meat consumption with blood cholesterol level among staff at Health Campus, USM. Blood cholesterol is highly associated with non-communicable diseases such as cardiovascular diseases (CVD), metabolic disorders and other non-communicable diseases. In fact, hypercholesterolemia cases are increasing in Malaysia. Modifiable factors such as body weight, blood pressure level and dietary pattern are appears to protect against the non-communicable diseases. Besides, people with family history of CVD and those that have been diagnosed with CVD are encouraged to adapt a healthy dietary and lifestyle in order to reduce the risk of high blood cholesterol. Therefore, studies on the epidemiology of high blood cholesterol level and intervention program are greatly important for prevention and reduction of the risk of cholesterol-related complications.

DISCLOSURE

The authors report no conflict of interest in this work.

ACKNOWLEDGEMENTS

The authors wish to express their deep appreciation to the participants for their cooperation in the study. We also thank Miss Chau Shin Hwa and Miss Amalina for the technical assistance provided.

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