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CASE-CONTROL RETROSPECTIVE STUDY ON CARDIOVASCULAR DISEASE RISK AND QUALITY OF LIFE AMONG MALAY ADULTS

MO MIN ERL[1], ASMA' ALI[1], ARNIE A. RAHIM[2], ANAM AMAN[1], SAKINAH HARITH[3] and HAYATI MOHD YUSOF[1*]

[1]*School of Food Science and Technology, Universiti Malaysia Terengganu (UMT), 21030 Kuala Nerus, Terengganu, Malaysia*
[2]*University Health Centre, Universiti Malaysia Terengganu (UMT), 21030 Kuala Nerus, Terengganu, Malaysia*
[3]*School of Nutrition and Dietetic, Faculty of Health Sciences, Universiti Sultan Zainal Abidin (UniSZA), Hafsah Block, Gong Badak Campus, 21300 Kuala Nerus*
[*]*E-mail: hayatimy@umt.edu.my*

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ABSTRACT

In recent years, cardiovascular disease (CVD) has become the top cause of mortality, morbidity, and hospitalization in Malaysia. This study aimed to identify the most significant CVD risk factor and protective factor among Malay adults in Kuala Terengganu, as well as to compare the quality of life between case and control groups. A case-control study via self-administered questionnaire was carried out among 130 respondents aged 23 to 56 years in Universiti Malaysia Terengganu (UMT) and Nursing College Kuala Terengganu to compare past exposure (retrospective) between case and control groups to CVD risk. In the present study, 68 of them were in a case group with high blood cholesterol (total cholesterol [TC] $\geq$ 5.18 mmol/L), while the other 62 were in a control group with the normal range of blood cholesterol (total cholesterol [TC] < 5.18 mmol/L). Purposive sampling was first applied to select the respondents in Kuala Terengganu. Then, consecutive sampling and quota sampling were performed in the study locations to recruit respondents, considering the type of respondents (case or control group) as a factor. The data were analysed using Independent-Samples t-test, Mann-Whitney U test, Chi-Square test and odds ratio (OR). The findings show no significant differences ($p > 0.05$) between the two groups in terms of CVD risk factors. However, by comparing the food frequency consumption scores, their fish consumption levels were found to be significantly different ($p = 0.010$). The control group had higher consumption (with a score of 60.8) compared to the case group (with a score of 50.8). Overweight or obesity was the only significant risk factor (OR: 2.13, 95% confidence interval [CI]: 1.06 to 4.29), while the only significant protective factor was the absence of any chronic diseases (OR: 0.00, 95% CI: 0.00 to 0.03), which were found to be associated with CVD, such as hypertension, diabetes mellitus and stroke. Furthermore, the quality of life of the control group was higher than that of the case group, but this difference was not significant ($p > 0.05$). Overweight or obesity is a major risk factor of CVD, while the absence of any chronic diseases is a major protector factor.

Key words: Case-control, cardiovascular disease, risk factor, quality of life, Malay adults

INTRODUCTION

A case-control study is a study that looks back retrospectively to compare how frequently the case and control groups are exposed to a risk factor to determine associations, if any, between the risk factor and the disease. The cases are those who have a well-defined outcome or known disease status, while the controls do not have the outcome or disease (Nesvick *et al.*, 2014). In recent years, CVD has become the top cause of mortality, morbidity and hospitalization in Malaysia (Aniza *et al.*, 2016). Due to epidemiologic and demographic transitions, CVD is not only affecting developed or Western countries, but also developing countries such as Malaysia (Fuster & Kelly, 2010).

CVD can be caused by modifiable risk factors such as hypertension, stroke, diabetes mellitus, high

* To whom correspondence should be addressed.

blood cholesterol, physical inactivity, overweight or obesity, unhealthy diet, harmful use of alcohol, cigarette smoking and psychosocial factors (depression, anxiety and stress), as well as non-modifiable risk factors such as higher age, male gender, race and positive family history (Amplavanar *et al.*, 2010; Akter *et al.*, 2010; Bernado *et al.*, 2013; Smilowitz *et al.*, 2010; Steptoe & Kivimaki, 2012). Additionally, low socioeconomic status is considered to be a contributor to CVD risk factors (Psaltopoulou *et al.*, 2017). Health-related quality of life factors such as physical, emotional and psychological incapacity have been considered as an important predictor for adverse health outcomes including mortality and hospitalization, independent of other risk factors (Mastenbroek *et al.*, 2014). According to Chin *et al.* (2014), CVD has a strong negative impact on the quality of life.

CVD occurs in both men and women of all races and age groups. This disease is described as a silent killer that does not become clinically apparent or without any symptoms until after it has done significant damage to the heart and arteries. The National Strategic Plan for Non-Communicable Disease (NSP-NCD) 2016–2025 is one of the interventions intended to further strengthen CVDs prevention and control programs in Malaysia by detection of risk factors and early identification of cardiovascular health (Ministry of Health Malaysia [MOH], 2016). Unfortunately, despite these efforts, the prevalence of CVD continues to rise at an alarming rate (Aniza *et al.*, 2016). Malays are found to have the highest CVD risk (Amal *et al.*, 2011). Thus, it is crucial to evaluate the most significant CVD risk factor to help control the disease prevalence among them.

Even though some research has been performed on the prevalence of CVD risk factors among Malaysian populations in different regions, the most significant cardiovascular risk factor remains inconsistent, as different risk factors such as obesity, hypertension and physical inactivity have been found to be the most prevalent risk factor in those studies, respectively (Amiri *et al.*, 2014; Ismail *et al.*, 2016; Aniza *et al.*, 2016). In addition, there are limited findings available on the CVD risk between CVD patient and non-CVD patient (Amani *et al.*, 2010). For instance, there is no previous study that has compared the quality of life between CVD patients and non-CVD patients, such as in a case-control retrospective study. It is well-recognised that dietary cholesterol such as saturated fats and trans-fat are associated with increased risk of CHD (Djousse & Gaziano, 2009). However, one controversial study claimed that there is a lack of association between dietary cholesterol and CVD risk (University of Eastern Finland, 2016). Thus, there is a need for re-evaluating the association between dietary cholesterol and CVD risk. The present study was carried out to identify the most significant CVD risk factors and protective factors among Malay adults in Kuala Terengganu. In addition, a comparison of quality of life between case and control groups was conducted.

MATERIALS AND METHODS

Research design

A case-control study was carried out between August and October 2017 in Universiti Malaysia Terengganu (UMT) and Nursing College Kuala Terengganu. The respondents were selected through purposive sampling, consecutive sampling and quota sampling by referring to Kelsey *et al.* (1996) for sample size calculation that required a minimum of 122 respondents. A total of 130 adults comprising of 68 cases (total cholesterol $\geq$ 5.18 mmol/L) and 62 controls (total cholesterol <5.18 mmol/L) were recruited, as shown in Figure 1. Case-control is an observational study that is designed to evaluate the exposure-disease relationship by enrolling cases and controls and comparing their exposure history. The research was approved by the Human Ethics Committee, Universiti Malaysia Terengganu (UMT/JKEPM/2018/14). Consent forms were signed and collected from all study participants.

Research instrument

A self-administered questionnaire was used as the research instrument in the present study. This questionnaire had six sections: socio-demographic information, medical and health status, lifestyle behaviours (smoking status, alcohol consumption and physical activity), dietary assessment by using food frequency questionnaire (FFQ), psychosocial status assessment by using Depression, Anxiety and Stress Scales-21 (DASS-21) and quality of life assessment by using 12-Item Short-Form Health Survey (SF-12). The reliability of the questionnaire was tested through the pilot test to determine the consistency of rating and correlation between each individual test items in the questionnaire. With the use of inter-item reliability and test-retest reliability, the consistency of the items was tested and the overall Cronbach's alpha of the items in the questionnaire was found to be greater than 0.70, which indicates good reliability. Face validity was used in this study, and the questionnaire was developed and modified from published journals and questionnaires of related studies (Angleman, 2010; Craig *et al.*, 2003; Hemani, 2013; Parsons, 1996; Tran, 2014; Ware *et al.*, 1996; Lovibond & Lovibond, 1995).

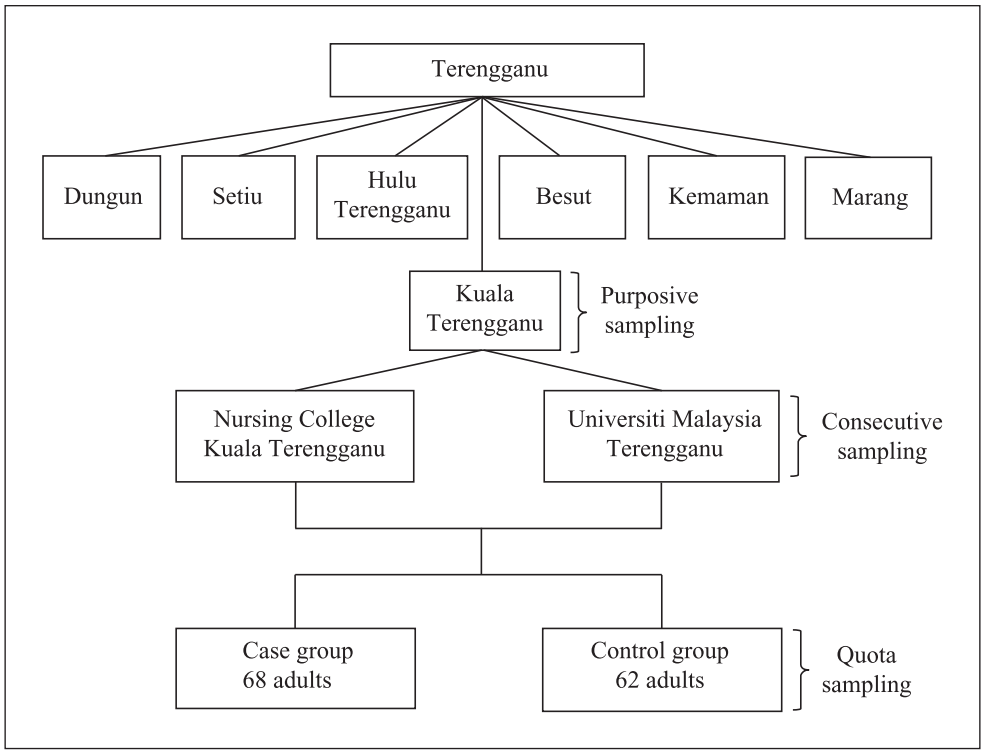

Fig. 1. Sampling framework.

Data collection procedure

The respondents were recruited among UMT staffs and students who met the research eligibility. All procedures done were approved by the Ethical Committee. After completing the questionnaires, their blood pressure, weight and height were measured and recorded. About 3 ml venous blood was drawn by nursing staffs at University Health Centre. The sample was allowed to stand at room temperature about 30 minutes and centrifuged at 15-24°C, 3000 rpm for 10 minutes. Serum obtained was kept frozen at -20°C until analysis at BP Healthcare Centre, Kuala Terengganu.

Data analysis

The data was analyzed using SPSS version 20. The Kolmogorov-Smirnov Test was used to determine the normality of the data. Descriptive tests were used to analyse the socio-demographic information, height, weight, body mass index (BMI), blood pressure and serum lipid profiles of the respondents. Besides, comparisons between case and control groups were done by using Chi-square, Independent-Samples t-test or Mann-Whitney U test, depending on the normality and types of the dependent variable. If the dependent variable was categorical, Chi-square was used. On the other hand, for data with the continuous dependent variable, if the data were normally distributed, Independent-Samples t-test was applied; but if the data was not normally distributed, Mann-Whitney U test was applied. The relative risk for CVD from a specific risk factor between case and control groups was estimated by using the odds ratio (OR). OR is a measure of association between for a case-control study. An OR of greater than 1.0 means that the odds of exposure may be a risk factor for the disease, the confidence interval (CI) and p-value with less than 0.05 to indicate statistical significance. Furthermore, FFQ, DASS-21, IPAQ and SF-12 were scored using their respective established scoring manuals (Chee *et al.*, 1996; Lovibond & Lovibond, 1995; IPAQ, 2005; Ware *et al.*, 1998).

RESULTS

Socio-demographic information

Based on Table 1, out of 130 total respondents, 68 of them were in case of a group with a median age of 37 (11) years, while the other 62 respondents were in control group with a median age of 34 (12) years. There was no significant difference ($p > 0.05$) between the case and control groups in terms of gender ($p = 0.404$) using a Chi-square test, but there was a significant difference ($p < 0.05$) between them with regard to age ($p = 0.005$) by using Mann-Whitney U test. The educational profile showed that most of the respondents had a university or college education. Almost half of the respondents had a monthly household income of RM3000 to RM6500. Only 12.7% of respondents were taking medications

Table 1. Socio-demographic characteristics of respondents

Category, n (%)	Total (n = 130)	Case (n = 68)	Control (n = 62)
Gender			
Male	37 (28.5)	22 (32.4)	15 (24.2)
Female	93 (71.5)	46 (67.6)	47 (75.8)
Age (year)	36 (11)[a]	37 (11)[a]	34 (12)[a]
20 – 29	22 (16.9)	5 (7.4)	17 (27.4)
30 – 39	62 (47.7)	33 (48.5)	29 (46.8)
40 – 49	34 (26.2)	22 (32.4)	12 (19.4)
50 – 59	12 (9.2)	8 (11.8)	4 (6.5)
Highest education level			
Secondary school	37 (28.5)	22 (32.4)	15 (24.2)
University/College	90 (69.2)	45 (66.2)	45 (72.6)
Others	3 (2.3)	1 (1.5)	2 (3.2)
Monthly household income			
< RM3000	58 (44.6)	28 (41.2)	30 (48.4)
RM3000 – RM6500	61 (46.9)	32 (47.1)	29 (46.8)
> RM6500	11 (8.5)	8 (11.8)	3 (4.8)
Medical status	17 (12.7)	7 (10.3)	10 (15.2)
Hypertension	8 (6.0)	4 (5.9)	4 (6.1)
Diabetes mellitus	2 (1.5)	0 (0.0)	2 (3.0)
High blood cholesterol	4 (3.0)	2 (2.9)	2 (3.0)
Others	3 (2.2)	1 (1.5)	2 (3.0)
None	117 (87.3)	61 (89.7)	56 (84.8)
Supplement			
Yes	18 (13.8)	12 (17.6)	6 (9.7)
No	112 (86.2)	56 (82.4)	56 (90.3)

[a]Data are presented as median (interquartile range).

for their respective diseases. Moreover, a majority of the respondents did not consume any supplements, while 13.8% of the respondents reported consuming supplements such as multivitamins, vitamin C, vitamin E, black seeds, apple cider vinegar, calcium tablets, omega 3 capsule and phytonatal.

Comparison of cardiovascular risk between case and control groups

There were no significant differences ($p > 0.05$) for all CVD risk factors between case and control groups (Table 2). This shows that they had no significant differences in terms of their lifestyle behaviours, socioeconomic and psychosocial status. Additionally, none of the respondents had experienced a stroke or consumed alcohol. As all the respondents are Malay and their religion, Islam, prohibits the consumption of alcohol, this risk factor was not taken into account in this study.

Fish frequency consumption of respondents

The only food frequency score that was significantly different ($p < 0.05$) between case and control groups was fish consumption, as the control group had higher frequency consumption (60.8) than that of the case group (50.8). Therefore, a higher frequency of fish consumption might be related to the protective factor for CVD. On the other hand, all other food consumption levels had no significant differences ($p > 0.05$) between the two groups as shown in Table 3. A majority of the food types had the same frequency category (less consumption) between case and control groups, except fish, eggs and fats. These three types of food were moderately consumed by the control group, while less consumed by the case group. However, egg and fat consumption levels were not significantly different ($p > 0.05$) between case and control groups in terms of food frequency scores.

Comparison of risk factors for cardiovascular disease between the case and control groups by odds ratio

Overweight or obesity was the most significant risk factor for CVD (OR: 2.13, 95% CI: 1.06 to 4.29) as shown in Table 4. This means that the overweight or obese case group had approximately two times the odds of CVD compared to the normal-weight control group. Those with a personal medical history of hypertension and currently smoking status had higher values of odds ratio than overweight or obesity at 2.17 (95% CI: 0.92 to 5.09) and 2.38 (95% CI: 0.44 to 12.74), respectively. However, these factors were not statistically significant ($p > 0.05$). Nevertheless, these factors tend to contribute to

Table 2. Comparison of cardiovascular risk factors between case and control groups

Risk factors	Case, n (%) (n = 68)	Control, n (%) (n = 62)	χ^2	p-value
Socioeconomic status				
Low education (Secondary school)	22 (16.9)	15 (11.5)	1.060	0.404
Low monthly household income (< RM3000)	28 (21.5)	30 (23.1)	2.217	0.330
Overweight/Obesity	39 (32.0)	24 (19.7)	4.415	0.110
Personal medical history				
Hypertension	20 (15.4)	10 (7.7)	3.223	0.113
Diabetes mellitus	0 (0.0)	2 (1.5)	2.228	0.226
Heart problems	0 (0.0)	1 (0.8)	1.105	0.477
Other diseases	2 (1.5)	3 (2.3)	0.316	0.669
Risk factors	Case, n (%) (n = 68)	Control, n (%) (n = 62)	χ^2	p-value
Family history				
Hypertension	27 (20.8)	19 (14.6)	1.164	0.371
Diabetes mellitus	20 (15.4)	21 (16.2)	0.299	0.721
High blood cholesterol	11 (8.5)	6 (4.6)	1.205	0.402
Stroke	3 (2.3)	2 (1.5)	0.123	1.000
Overweight/Obesity	5 (3.8)	3 (2.3)	0.355	0.720
Heart problems	10 (7.7)	6 (4.6)	0.760	0.546
Other diseases	3 (2.3)	2 (1.5)	0.123	1.000
Low physical activity	27 (20.8)	22 (16.9)	1.763	0.414
Smoking				
Currently smoking	5 (3.8)	2 (1.5)	1.084	0.514
Previously smoking	6 (4.6)	3 (2.3)	2.013	0.365
Psychosocial status				
Depression	16 (12.3)	12 (9.2)	0.334	0.715
Anxiety	29 (22.3)	23 (17.7)	0.416	0.641
Stress	14 (10.8)	9 (6.9)	0.821	0.499

$p > 0.05$ indicates no significant difference by using the Chi-square test.

Table 3. Food frequency consumption scores• of respondents

Types of food	Consumption scores		p-value
	Case (n = 68)	Control (n = 62)	
Fruit	54.1	54.8	0.842
Vegetable	71.1	70.3	0.820
Poultry	65.7	67.1	0.691
Meat	41.0	45.2	0.242
Fish	50.8	60.8	0.010*
Nuts	41.7	41.8	0.977
Beans	40.1	41.8	0.630
Dairy products	47.5	50.5	0.398
Eggs	56.7	60.2	0.326
Whole grains	40.1	45.4	0.144
Fats	57.3	63.7	0.082
Pastries	45.4	46.8	0.691
Fast foods	35.5	41.5	0.101
Carbonated soft drinks	23.7	27.0	0.354
Caffeinated drinks	49.4	53.7	0.231

* $p < 0.05$ indicates significant different between case-control group by using Independent-Samples T test.

• Score range: 0–100; score 20.0–59.9 = less consumed foods, 60.0–79.9 = moderately consumed foods.

Table 4. Comparison of risk factors between the case and control groups by Odds Ratio

Risk factors	OR (95% CI)	p-value
Socioeconomic status		
Low education (Secondary school)	1.47 (0.68 – 3.19)	0.333
Low monthly household income (< RM3000)	0.75 (0.37 – 1.49)	0.409
Personal medical history		
Hypertension	2.17 (0.92 – 5.09)	0.076
Diabetes mellitus	0.18 (0.01 – 3.75)	0.266
Heart problems	0.30 (0.01 – 7.48)	0.463
Other diseases	0.60 (0.10 – 3.69)	0.578
Family history		
Hypertension	1.49 (0.72 – 3.08)	0.282
Diabetes mellitus	0.81 (0.39 – 1.71)	0.585
High blood cholesterol	1.80 (0.62 – 5.20)	0.277
Stroke	1.38 (0.22 – 8.57)	0.727
Overweight/Obesity	1.56 (0.36 – 6.82)	0.554
Heart problems	1.61 (0.55 – 4.72)	0.387
Other diseases	1.38 (0.22 – 8.57)	0.727
Overweight/Obesity	2.13 (1.06 – 4.29)	0.035*
Low physical activity	1.20 (0.59 – 2.44)	0.620
Smoking		
Currently smoking	2.38 (0.44 – 12.74)	0.311
Previously smoking	2.00 (0.48 – 8.36)	0.342
Psychosocial status		
Depression	1.28 (0.55 – 2.98)	0.564
Anxiety	1.26 (0.62 – 2.55)	0.519
Stress	1.53 (0.61 – 3.83)	0.367

*$p < 0.05$ indicates significant different.

CVD risk as well. For other risk factors which had an odds ratio of more than 1.0, since they were not statistically significant ($p > 0.05$), they were also not considered as significant risk factors of CVD.

Comparison of protective factors for cardiovascular disease between the case and control groups by odds ratio

The only protective factor of CVD was the absence of a personal medical history of hypertension, diabetes mellitus, stroke and heart problems (OR: 0.00, 95% CI: 0.00 to 0.03), as shown in Table 5. This means that the control group experienced an almost 100% decrease in odds of CVD compared to the case group with the absence of those diseases. However, the absence of those individual chronic diseases alone has been shown to have no protective effect against CVD. This indicates that a person must be free from any chronic diseases to have a reduced risk of CVD. All other protective factors (except high monthly household income; absence of personal medical history of diabetes mellitus, heart problems and other diseases; as well as absence of family history of diabetes mellitus) had odds ratio of lower than 1.0, but they were not statistically significant ($p > 0.05$), and thus are not considered significant protective factors of CVD.

Quality of life of respondents

For the health-related quality of life, results found that both the physical component summary (PCS) and mental component summary (MCS) scale scores of the control group were higher than those of the case group; 51.48 vs. 48.93 and 53.15 vs. 50.51, respectively. This shows that the control group had a higher quality of life, both physically and mentally, compared to the case group. However, they were not significantly different ($p > 0.05$).

DISCUSSION

In the present study, it was found that there were no significant differences ($p > 0.05$) between case and control groups in terms of all the CVD risk factors investigated. This is similar to the result by Wang *et al.* (2017) involving 46,000 cases and controls of CVD in China, which reported no significant difference ($p > 0.05$) in terms of physical activity

Table 5. Comparison of protective factors between the case and control groups by Odds Ratio

Protective factors	OR (95% CI)	p-value
Socioeconomic status		
High education (University/College)	0.68 (0.31 – 1.48)	0.333
High monthly household income (> RM6000)	2.62 (0.66 – 10.37)	0.169
Normal BMI	0.70 (0.35 – 1.40)	0.314
Absence of personal medical history	0.00 (0.00 – 0.03)	< 0.001*
No hypertension	0.46 (0.20 – 1.08)	0.076
No diabetes mellitus	5.66 (0.27 – 120.26)	0.266
No heart problems	3.34 (0.13 – 83.56)	0.463
No other disease	1.68 (0.27 – 10.39)	0.578
Absence of family history	0.70 (0.35 – 1.41)	0.320
No hypertension	0.67 (0.32 – 1.39)	0.282
No diabetes mellitus	1.23 (0.59 – 2.58)	0.585
No high blood cholesterol	0.56 (0.19 – 1.60)	0.277
No stroke	0.72 (0.12 – 4.47)	0.727
No overweight/Obesity	0.64 (0.15 – 2.80)	0.554
No heart problems	0.62 (0.21 – 1.82)	0.387
No other diseases	0.72 (0.12 – 4.47)	0.727
High physical activity	0.58 (0.26 – 1.31)	0.188
No smoking	0.42 (0.08 – 2.25)	0.311
Psychosocial status		
Normal depression	0.78 (0.34 – 1.81)	0.564
Normal anxiety	0.79 (0.39 – 1.60)	0.519
Normal stress	0.66 (0.26 – 1.64)	0.367

*$p < 0.05$ indicates significant different.

level, where the proportions of the case and control groups were 40.8 (95% CI: 35.2 to 46.6) and 41.3 (95% CI: 35.7 to 47.1), respectively.

Besides, fish consumption among the controls was significantly higher ($p < 0.05$) than that of the case group. The protective effect of fish consumption among the controls was in agreement with a study by He *et al.* (2004), which reported that individuals who ate fish once per week had significantly lower coronary heart disease mortality rates (RR: 0.85, 95% CI: 0.76 to 0.96) than those who never consumed fish or ate fish less than once per month. Mozaffarian and Rimm (2006) also reported that modest consumption of fish (1 to 2 servings per week), especially those higher in the omega-3 fatty acids, reduced the risk of coronary death by 36% (95% CI: 20% to 50%, $p < 0.001$) and total mortality by 17% (95% CI: 0% to 32%, $p = 0.046$). In addition, based on the results from a systematic review and meta-analysis of 16 prospective studies, for each serving increment of fish consumption per week, the risk ratio (RR) (95% CIs) of type 2 diabetes was 0.98 (0.97 to 1.00) in Asian studies (Wallin *et al.*, 2012). According to Peter *et al.* (2013), the omega-3 fatty acids that are mainly beneficial for heart are eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), which can be found mostly in fatty fish such as tuna, salmon, sardine, mackerel, herring, carp (*jelawat)*, perch (*siakap*) and tilapia. Among 2,675 Malaysian adults of different ethnicities in Peninsular Malaysia, the most frequently consumed marine fish was Indian mackerel, followed by anchovy, scads, tuna and sardines. The most frequently consumed freshwater fish were freshwater catfish and snakehead (Ahmad *et al.*, 2016).

Even though eggs and fats are major sources of dietary cholesterol, the present study shows that moderate but higher intakes among the control group as compared to the case group did not appear to greatly affect about the serum cholesterol level of the controls. Previously, there was a consensus that dietary cholesterol, including egg yolk, is harmful to the arteries. However, findings by the University of Eastern Finland (2016) revealed that high intake of dietary cholesterol, or eating an egg every day, did not have a significant association with CVD risk, even among those who are genetically predisposed to a greater effect of dietary cholesterol on serum cholesterol levels. Additionally, a meta-analysis about the association between egg consumption and coronary heart disease reported that consumption of up to one egg daily may decrease the risk of total stroke, while daily egg intake was not associated with the risk of coronary heart disease (Alexander *et al.*, 2016).

Overweight or obesity as the most significant risk factor of CVD in the present study, in line with a study by Aniza *et al.* (2016) which revealed that obesity (51.2%) was the most prevalent CVD risk factor among 1,489 Malaysian adults. Another study by Amiri *et al.* (2014) among 2,360 Malaysian adults also identified obesity (54.8%) as the predominant risk factor. Overweight or obesity has many adverse effects on cardiovascular structure and function, not only related to but also independently predicting coronary atherosclerosis. In other words, it is an independent risk factor for CVD. Tedstone (2017) reported that metabolically healthy obese people had a 28% increased risk of CVD as compared to people of normal weight and metabolically healthy (hazard risk [HR]: 1.28, 95% CI: 1.03 to 1.58). This shows that being obese or overweight was associated with CVD even without other metabolic risk factors. Furthermore, there was a strong association between obesity and hypertension (Akil & Ahmad, 2012). Hypertension was approximately three times more common in people with overweight or obesity than normal weight person.

The present study has revealed that the personal medical history of hypertension was not a significant risk factor of CVD. This is not in line with the previous finding by Stevens *et al.* (2016), as increased systolic blood pressure (SBP) was associated with increased risk of CVD events (HR: 1.18, 95% CI: 1.07 to 1.30) and CVD mortality (HR: 1.18, 95% CI: 1.09 to 1.28). Compared with normal blood pressure (< 120/80 mmHg), HRs (95% CIs) for CVD were 1.41 (1.31 to 1.53) for prehypertension, and 3.42 (3.17 to 3.70) for systolic-diastolic hypertension (Arima *et al.*, 2012). Furthermore, current smoking status was also found to be not a significant risk factor in this study. Only seven people were smoking cigarettes currently, and all of them were males. No females reported smoking. In addition, the number of male respondents was only 37, which was about 2.5 times less than the female respondents (n = 93). This makes it possible that only a few respondents were smoking since only males tend to have smoking habits. Due to these postulated reasons, there might be a type II error which caused a bias or deviation to the outcome. Thus the result was not in line with some previous findings. Nancy and Carole (2013) found that smoking was an important risk factor for CVD, where it accounted for 10% of all CVD occurrences. A similar finding by Stallones (2015) showed that smokers were two times more vulnerable to coronary heart disease compared to non-smokers, whether in terms of death, prevalence or the incidence of new events. In addition, middle-aged adults had approximately two times the risk compared to other age groups (Nancy and Carole, 2013).

Absence of chronic diseases such as hypertension, diabetes mellitus and heart problems was the only significant protective factor of CVD. This finding is in line with Špinar (2012), where a tight blood pressure control (< 130 mmHg) of SBP was applied to 758 hypertensive patients and there were decreases of cerebrovascular event rate (RR: 0.56, 95% CI: 0.35 to 0.89) and heart failure rate (RR: 0.44, 95% CI: 0.20 to 0.94) among them. In addition, research done by Bundy *et al.* (2017) revealed that randomized groups among 144,220 people with a SBP of 120 to 124 mmHg had a 42% lower risk (HR: 0.58, 95% CI: 0.48 to 0.72) of major CVD compared to those with 140 to 144 mmHg SBP. Hence, it can be concluded that reduced blood pressure or absence of hypertension can protect against CVD.

These findings are also in line with Mannucci *et al.* (2009), who reported that an intensified treatment for type 2 diabetes mellitus, which successfully reduced the mean HbA1c by 0.9% on average, was associated with a significant reduction ($p < 0.05$) of all incidences of cardiovascular events (OR: 0.89, 95% CI: 0.83 to 0.95) and myocardial infarction (OR: 0.86, 95% CI: 0.78 to 0.93). A study by Rodgers (2004) among patients with stroke and ischemic heart disease (n = 27,996) found that each 1 mmol/L lower in fasting glucose level had caused 21% lower risk of stroke (HR: 0.79, 95% CI: 0.76 to 0.82) and 23% lower risk of ischemic heart disease (HR: 0.77, 95% CI: 0.73 to 0.81). Therefore, it can be considered that controlled blood glucose level or absence of diabetes mellitus is protective against CVD.

Quality of life of the case group was found to be lower than that of the control group. According to Shafie *et al.* (2011), the mean scores of PCS and MCS among 596 Malaysian adults with a mean age of 35.7 years were 48.9 and 49.1, respectively. Therefore, PCS and MCS scores of the respondents were average or slightly higher than the mean scores among the Malaysian population. This indicates that the health status of the respondents was at a normal level.

CONCLUSION

Generally, there were no significant differences ($p > 0.05$) in terms of all the risk factors between the case and control groups. However, for dietary intake, fish consumption was significantly higher ($p < 0.05$) in the control group compared with the case group. Thus, the control group might benefit from protection against the risk of CVD due to higher consumption of fish. In addition, despite the common belief that higher intake of dietary fat was associated with CVD risk, no such association was

found. The present study additionally revealed that among the risk factors studied, overweight or obesity was the only significant contribution for CVD. The most significant protective factor determined was the absence of any personal medical history of hypertension, diabetes mellitus, stroke and heart problems. The PCS and MCS scores of both groups were higher than those of the mean scores among Malaysian adults. However, there were no significant differences ($p > 0.05$) with regard to PCS and MCS scores between the two groups.

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