Malays. Appl. Biol. (2018) 47(6): 77–86

ASSESSMENT OF HEALTH AND NUTRITIONAL STATUS OF LIPID LOWERING SUPPLEMENT USERS IN KUALA LUMPUR

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Accepted 26 July 2018, Published online 31 December 2018

ABSTRACT

The nutritional and health status of dietary supplements users have been widely studied in other countries. However, few studies have examined lipid-lowering supplements users in Malaysia. Findings are inconsistent concerning the effectiveness of lipid-lowering supplements on cholesterol levels. Hence, this study was aimed to determine the health (physical, mental and social levels) and nutritional status (BMI, blood pressure and lipid profile) of lipid lowering supplement users. A cross sectional study of one hundred lipid lowering supplement subjects was conducted; body weight, height, blood pressure and lipid profile were measured. The results found that majority of the supplement users had normal physical, mental, and social health levels and normal level of lipid profiles, except for HDL-c and LDL-c than the non-users. Results also show an association ($p<0.005$) between lipid lowering groups (fish oil and flaxseed oil, soluble fiber and phytosterol) and body fat percentage ($p=0.002$). These findings suggest that in general lipid lowering supplements may have beneficial influence on the mental and social health status, and nutritional status (i.e. TC and TG, blood pressure, body fat percentage).

Key words: Health status, nutritional status, lipid-lowering supplements, lipid profile, blood pressure

INTRODUCTION

Garlic supplement, ginseng, ginkgo biloba, fish oils, soy supplements and flaxseed oil were among the most commonly consume lipid lowering supplements among cardiovascular disease (CVD) patients (Yeh *et al.,* 2006). Lipid-lowering supplements help to reduce or prevent an increase in blood serum cholesterol levels (Chen *et al.*, 2010). Studies on the nutritional status of lipid lowering supplement users have indicated that lipid-lowering supplements generally significantly improve lipid profile in terms of total cholesterol (TC), high lipid lipoprotein density cholesterol (HDL-c), triglycerides (TG), and low lipoprotein density cholesterol (LDL-c) (Mohamad *et al.*, 2014; Yeap *et al.*, 2014) without a substantial risk of muscle pain (Hainer, 2009). In contrast to the lipid lowering supplements, the currently available lipid-lowering drugs (e.g. statins) act in reducing low-density lipoproteins cholesterol (LDL-c) levels by inhibiting the action of 3-hydroxy-3methylglutaryl coenzyme A (HMG-CoA) reductase (Opie & Dphil, 2015). However, cholesterol itself is not merely a final product, but also an intermediate to a suite of additional products such as sex steroids, bile acids, and vitamin D, which are all affected by statin administration. Muscle adverse effects are emphasized, as they are the best recognized adverse effect of statins (Golomb & Evans, 2008).

Health status can be defined as the range of manifestation of diseases in a given patient including functional limitation, symptoms appeared, and quality of life, in which quality of life is the divergence between reality and ideal function (Rumsfeld, 2002). Poor health status linked to physical and mental illness such as coronary heart disease and depression, respectively (Mental Health Foundation, 2011). Previous studies have revealed that the health status of lipid lowering supplement users were being improved in terms of physical (blood pressure), mental (depression symptoms) and social health among hypertensive subjects, older adults, and the general public (Ried *et al.*, 2013; Ehrlich, 2015; Uchino, 2006).

However, studies have also revealed that lipid-lowering supplements do not significantly improve lipid profile (Park *et al.*, 2012; Ottestad *et al.*, 2013).

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Inconsistent findings for the effectiveness of lipid-lowering supplements on reducing cholesterol remain controversial. For instance, no significant reduction was found in LDL-c levels with the consumption of phytosterol capsules (2 g/day) as compared to the placebo among hyper-cholesterolemia subjects (Ottestad *et al*., 2013). However, a dose of 3 g/day lowers LDL-c by 15% according to Gylling and Simonen (2015) among type 2 diabetes and overweight-obese subjects with metabolic syndrome. These differences may be due to the different dose of supplements, dissimilarity of research design, and other factors such as the varying lifestyle and dietary habits of respondents in different studies.

Despite this, few studies have been carried out on the nutritional status of lipid lowering supplement users in Malaysia compared to studies done on nutritional status of general dietary supplements users. Therefore, the current study is important to further investigate the health benefits of lipid-lowering supplements on lipid profile, BMI, blood pressure, mental and social health and risk factors of CVD and hypertension among healthy population. The findings of the present study could provide information to health-related organizations or health government ministries to further investigate the efficacy of lipid-lowering supplements in lowering blood serum cholesterol. This study aims to determine the health and nutritional status of lipid lowering supplement users, the health benefits of lipid lowering supplement, and the association between different types of lipid-lowering supplements and the health and nutritional status of supplement users.

MATERIALS AND METHODS

This present cross-sectional study was conducted in Kuala Lumpur this study site was chosen as it is highly populated and may accurately estimate population values (Murray & Kujundzic, 2005). Based on the Yamane formula for determining number of sample size, a total of 100 lipid lowering supplement users in Kuala Lumpur were conveniently selected (Yamane, 1967). Respondents aged 18 years old and above, and with the consumption of lipid lowering supplement were chosen. This survey carried out for 2 months starting from 1st July until 31st August 2015. The data was collected during weekends and weekdays. This study was registered in the National Medical Research Register (NMRR) for ethical approval (NMRR-15-829-24996). All respondents signed an informed consent form prior to data collection.

This study used a bilingual self-administered validated questionnaire consists of five sections: a) socio-demographic information; b) general background; c) mental health assessment; d) social health assessment; and e) nutritional status assessment. Section A of questionnaire consisted of questions pertaining to socio-demographic variables. Data such as gender, age, race, educational level, marital status and monthly income were assessed and the scale used were nominal scale except for age which was ratio scale. Section B obtained information on smoking habits, alcohol consumption, types of lipid-lowering supplements intake, existing diseases, family history of diseases and current level of physical activity. The scale used in section B was a nominal scale.

In section C, subjects were assessed for their mental health with the Depression Anxiety and Stress Scale (DASS) to test stress and depression levels based on a 4-point rating scale developed by the Australian Centre for Post-Traumatic Mental Health; 0 = Did not apply to me at all, 1 = Applied to me to some degree, or some of the time, 2 = Applied to me to a considerate degree, or a good part of time, and 3 = Applied to me very much, or most of the time. Their total scores were calculated in order to analyze their stress and depression condition. The scores obtained were multiplied by 2 (Lovibond & Lovibond, 1995). Table 1 shows the scoring information for DASS severity ratings.

For Section D, subjects were assessed for their social health using Cohen & Hoberman's (1983) 12-item scale to measure perceptions of social support. For items 1, 2, 7, 8, 11 and 12, assign each response a numerical value as follows: Definitely true = 0; probably true = 1; probably false = 2; definitely

Table 1. Scoring information for DASS Severity Ratings

	Stress (Q1-7) Range in %	Depression (Q8-14) Range in %
Normal	0.0 – 33.3	0 – 21.4
Mild	35.7 – 42.9	23.8 – 31.0
Moderate	45.2 – 59.5	33.3 – 47.6
Severe	61.9 – 78.6	50.0 – 64.3
Extremely Severe	81.0 – 100.0	66.7 – 100.0

Note: Depression Anxiety and Stress Scale (DASS) items; Q1=I found it hard to calm down, Q2=I tended to over-react to situations, Q3=I felt that I was using a lot of nervous energy, Q4=I found myself getting agitated, Q5=I found it difficult to relax, Q6=I was intolerant of anything that kept me from getting on with what I was doing, Q7=I felt that I was rather touchy, Q8=I couldn't seem to experience any positive feeling at all, Q9=I found it difficult to work up the initiative to do things, Q10=I felt that I had nothing to look forward to, Q11=I felt down-hearted and blue, Q12=I was unable to become enthusiastic about anything, Q13=I felt I wasn't worth much as a person, and Q14=I felt that life was meaningless.

false = 3. For the remaining items assign each response a numerical value as follows: Definitely true = 3; probably true = 2; probably false = 1; definitely false = 0. The scores will be summed up and classified into either low (0-12 points), moderate (13-24 points), or high levels (25-36 points) of social support accordingly.

For the last section, the respondents were evaluated for their nutritional status via anthropometric, biochemical, clinical and dietary assessments. Height, body weight and body fat were measured using a measuring tape and Karada scan respectively. BMI was calculated from the Quetelet's formula: BMI (kg/m^2) = body weight (kg) / height (m^2) (WHO, 2006). Lipid profiles, including total cholesterol (TC), high density lipoprotein (HDL-c), triglyceride (TG) and low-density lipoprotein (LDL-c), were evaluated. Respondents were tested for their lipid profile (TC, HDL, TG and LDL in whole blood) using Cardiocheck Pa and PTS Panels Lipid Panel test strips (PTS Diagnostics, USA). TC, HDL-c, TG, LDL-c were then categorized based on the ATP III US National Cholesterol Education Program (NCEP) (2001). In clinical assessment, blood pressure was measured using an Omron Automatic Blood Pressure Monitor (Omron Healthcare, US) and classified according to the categorization used in NHMS III (Ministry of Health Malaysia, 2006). In diet assessment, dietary intake was measured by using food frequency questionnaire (FFQ), which uses an ordinal scale. Food intake scores were calculated based on Chee *et al*. (2010) and was classified into either extreme low (< 25.5%), low (25.5–59.9%), medium (60–79.9%) or high intake (80–100%). The data was analyzed using SPSS version 20.0. Kolmogorov-Smirnov test was used to check normality prior analysis. Frequency and percentage were used to depict the descriptive distributions of socio-demographic, mental health, social health and nutritional status findings. Chi-square test was used to determine the association between lipid-lowering supplements and lipid profile, physical health, mental health, social health and nutritional status if conditions fulfilled, while the Fischer Exact test was used if two conditions of chi-squares (no more than 20 percent of cells in the contingency table should have expected values less than five and no cell has an expected value of less than one) were not fulfilled (Connolly, 2007). P value less than 0.05 was considered as significant.

RESULTS AND DISCUSSION

Socio-demographic characteristics of respondents

Table 2 shows the socio-demographic characteristics of respondents. More than half (59%) of respondents were female and most were between 18 to 34 years old. According to Petry (2002), young adults are those between 18 to 35 years old. Therefore, the proportion of young adults in this study was approximately 61%, which is sufficient to represent the sample population (young adults) in the present study. Among the three main races, half of the lipid-lowering supplements users were Chinese (50%), followed by Malay (37%) and Indian (12%). About 64% of the respondents had higher educational level, as either diploma or degree holders. Out of the 10 lipid-lowering supplements, fish oil was the most popular. More than half of the respondents were lightly active in their daily life, followed by sedentary lifestyle.

Mental and social health characteristics of respondents

Table 3 shows the mental and social health characteristics of lipid lowering supplement users.

Table 2. Socio-demographic characteristics of respondents (n = 100)

Characteristics	N	%
Gender		
Male	41	41.0
Female	59	59.0
Age group (Median=30, Q_1=23; Q_3=43)		
18-24	37	37.0
25-34	24	24.0
35-44	15	15.0
45-54	15	15.0
55-64	9	9.0
Race		
Malay	37	37.0
Chinese	50	50.0
Indian	12	12.0
Others	1	1.0
Education		
Primary	5	5.0
Secondary	23	23.0
Diploma	12	12.0
Bachelor degree	52	52.0
Others	8	8.0
Lipid lowering supplement		
Fish oil	43	43.0
Ginkgo Biloba	8	8.0
Garlic	4	4.0
Soluble fiber	16	16.0
Red yeast rice extract	5	5.0
Phytosterol	1	1.0
Ginseng	2	2.0
N. sativa and honey mixture	1	1.0
Soy	11	11.0
Flaxseed oil	5	5.0
Others	4	4.0
Perceived physical level		
Sedentary	35	35.0
Lightly active	54	54.0
Fairly active	9	9.0
Highly active	2	2.0

Based on Table 3, the current study showed that most lipid lowering supplement users were in a normal mental state and social health levels.

There were two separate parts of the mental health assessment, namely stress level and depression level. The stress scale is sensitive to levels of chronic non-specific arousal. It assesses difficulty relaxing, nervous arousal, and being easily upset/agitated, irritable/over-reactive or impatient while the depression scale assesses dysphoria, hopelessness, devaluation of life, self-deprecation, lack of interest/involvement, anhedonia, and inertia (Lovibond & Lovibond, 1995). Results showed that the percentages of respondents with normal level of stress and depression were 75% and 66%, respectively. This has been seen in the daily consumption of 1.5-1.8 g DHA in fish oil can reduced stress and decreased the aggressive tendencies of young adults, possibly by modulating stress (Lajtha *et al*., 2009). Another distinction example can be seen through ingestion of Ginkgo biloba standardized extract, 40 to 80 mg, 3 times daily, can relieved depression. A few studies looking at ginkgo for treating memory problems in older adults have been reported to show improvement in depression symptoms (Ehrlich, 2015).

In terms of social health, about 58% of respondents were at a high level. According to Cohen (2004), social support may have indirect effects on health by enhancing mental health, decreasing the impact of stress, or fostering a sense of meaning and purpose in life. Supportive social ties may trigger physiological effects such as reduction of heart rate, blood pressure and stress hormones that are beneficial to health and minimize unpleasant arousal (Uchino, 2006).

Lipid profile characteristics of respondents

Table 4 shows the lipid profile (TC, HDL-c, TG and LDL-c) characteristics of lipid lowering supplement users. Based on Table 4, most respondents generally had a normal reading for lipid profile, except for HDL-c and LDL-c, which were in the moderate and near optimal category, respectively.

The median levels of TC and TG among users were 4.72 mmol/L (Q_1 = 4.39, Q_3 = 4.92) and 1.35 mmol/L (Q_1 = 1.12, Q_3 = 1.49), which were in the desirable and normal category, respectively. The results obtained were similar with previous studies that reported lipid-lowering supplements users had a significant decrease in mean serum TC by 0.136 mmol/L and TG by 0.162 mmol/L (Reynolds *et al*., 2006); fish oil users had a significant decreased in TG by 0.34 mmol/L (Eslick *et al*., 2009); flaxseed oil users had a significant reduce in TC by 5.0% ($p<0.01$) (Kontogianni *et al*., 2013) and *N. sativa* and honey users also had a significant decrease in TC by 6.2% in the hypercholesteromic group (Mohamad *et al*., 2014). However, the levels of lipid profile of respondents were not determined before supplementation; thus, the effect cannot be directly verified.

On the other hand, the median of HDL-c and LDL-c among users were in the moderate and near optimal category, respectively. The results obtained were similar to those of 47 previous studies which reported that an average dose of 3.25 g/day of omega-3 fish oils provides very slight increase in HDL-c (0.01 mmol/L) and LDL-c (0.06 mmol/L) (16,511 individuals with cardiovascular risk factors) (Eslick *et al*., 2009). Phytosterol intake (2 g/day) for four weeks provided no significant reduction in

Table 3. Mental and social health characteristics of respondents

Characteristics	N	%	Median (Q_1, Q_3)
Stress Level (range of score)			
Normal (0-7)	75	75.0	
Mild (7.5-9)	13	13.0	
Moderate (9.5-12.5)	8	8.0	5.00 (3.00, 7.75)
Severe (13-16.5)	2	2.0	
Extremely severe (17-21)	2	2.0	
Depression level (range of score)			
Normal (0-4.5)	66	66.0	
Mild (5-6.5)	21	21.0	
Moderate (7-10)	10	10.0	3.00 (1.00, 5.00)
Severe (10.5-13.5)	2	2.0	
Extremely Severe (14-21)	1	1.0	
Social Health level (range of score)			
Low (0-12)	6	6.0	
Moderate (13-24)	36	36.0	29.00 (27.00, 31.00)
High (25-36)	58	58.0	

Abbreviations: Q_1 = First quartile and Q_3 = Third quartile.

Table 4. Lipid profile and blood pressure characteristics of respondents

Characteristics	n	%	Median (Q_1, Q_3)
TC category/Value (mmol/L)			
Desirable (<5.18)	92	92.0	4.72 (4.39, 4.92)
Borderline to high (5.18-6.20)	4	4.0	
High (> 6.20)	4	4.0	
HDL-c category/Value (mmol/L)			
Low (< 1.04)	12	12.0	1.40 (1.22, 1.58)
Moderate (1.04 – 1.54)	56	56.0	
High (≥ 1.55)	32	32.0	
TG category/Value (mmol/L)			
Normal (< 1.70)	95	95.0	1.35 (1.12, 1.49)
Borderline to high (1.70-2.25)	2	2.0	
High (2.26-5.64)	2	2.0	
Very high (>5.65)	1	1.0	
LDL-c category/Value (mmol/L)			
Optimal (<2.59)	41	41.0	2.70 (2.38, 2.97)
Near optimal (2.59-3.35)	50	50.0	
Borderline high (3.36-4.12)	6	6.0	
High (4.13-4.90)	3	3.0	
Systolic category/Value (mmHg)			
Optimal (< 120)	65	65.0	116.83 (11.49)
Normal (< 130)	25	25.0	
High Normal (130-139)	7	7.0	
Hypertension class I (140-159)	2	2.0	
Hypertension class II (160-179)	1	1.0	
Diastolic category/Value (mmHg)			
Optimal (< 80)	70	70.0	77.00 (70.25, 80.00)
Normal (< 85)	23	23.0	
High Normal (85-89)	5	5.0	
Hypertension class I (90-99)	1	1.0	
Hypertension class II (100-109)	1	1.0	

Abbreviations: Q_1 = First quartile; Q_3 = Third quartile; TC = Total cholesterol; HDL-c = High density lipoprotein cholesterol; TG = Triglycerides and LDL-c = Low density lipoprotein cholesterol.

LDL-c levels when compared to the placebo period (-0.01 mmol/L) and no significant changes were found in the plasma levels of HDL-c in participants with TC 4.7-7.7 mmol/L and with fasting TG ≤ 4.0 mmol/L (n=41) (Ottestad *et al*., 2013). Flaxseed oil showed no significant effect on LDL-c levels (Shim *et al*., 2014).

However, some previous studies reported contrasting results. Flaxseed oil (15 mL/day) for six weeks exhibited significant reduction in LDL-c (-6.7%) of young, healthy, normal weight adults (n=37) (Kontogianni *et al*., 2013), while 1200 mg of red yeast rice at bedtime reduced LDL-c of 25 patients intolerant to daily statins by 21% (-35 ± 25 mg/dL) for ≥ 4 weeks (Venero *et al*., 2010). Additionally, 20 to >61 g/day soy protein supplementation was associated with a signification reduction in mean serum LDL-c (-4.25 mg/dL) and a significant increase in HDL-c (0.77 mg/dL) in a meta-analysis of 41 trials with sample size from 4 to 179 normal adults.

Blood pressure characteristics of respondents

Table 4 shows the blood pressure characteristics of lipid lowering supplement users. The medians of systolic and diastolic values of users were 116.83 and 77.00 mmHg, respectively, which are both in the optimal category. This is supported by previous studies showing that 3 months of ginkgo biloba intake led to a 6% reduction in systolic blood pressure and a 21% reduction in diastolic blood pressure in a slightly older, pre-hypertensive population (Kudolo, 2000); and that mean systolic blood pressure was significantly reduced by 11.8 ± 5.4 mmHg in the group of respondents that took two capsules of garlic supplement over 12 weeks (Ried *et al*., 2013).

Body Mass Index and body fat percent characteristic of respondents

Table 5 shows the BMI and body fat percentage characteristic of lipid lowering supplement users for male and female separately. The median values

Table 5. Body Mass Index and body fat percentage characteristic of lipid lowering supplement users for male and female respectively

Characteristics	Male (n = 41)			Female (n = 59)		
	n	%	Median (Q_1, Q_3) or Mean (SD)	n	%	Median (Q_1, Q_3) or Mean (SD)
BMI category						
Underweight	0	0	24.44 (22.32, 26.97)	4	6.8	22.64 (20.71, 25.73)
Healthy weight	17	41.5		26	44.1	
Overweight	14	34.1		17	28.8	
Obese	10	24.4		12	20.3	
Body fat category						
Less than essential fat	0	0	20.24 (9.93)	6	10.2	17.20 (12.50, 27.60)
Essential fat	0	0		11	18.6	
Athletes	7	17.1		22	37.3	
Fitness	13	31.7		2	3.4	
Average	13	31.7		5	8.5	
Obese	8	19.5		13	22.0	

Abbreviations: SD: Standard deviation; Q_1 = First quartile; Q_3 = Third quartile and BMI = Body mass index.

of BMI for male and female were 24.44 kg/m^2 and 22.64 kg/m^2, respectively, both in normal weight category based on the WHO classification. The mean of body fat in the present study for males was 20.2% while the median for females was 17.2%. The mean body fat percentage among normal urban Malaysians for both male and female were 21.0% and 31.1%, respectively (Chee *et al*., 1997). In comparison, body fat percentage for lipid lowering supplement users, especially females, was lower than that of normal adults in Malaysia.

Among the 59 female respondents, 37% of them have lightly to fairly active physical levels. Wu and O'Sullivan (2011) stated that women generally have a higher proportion of body fat compared to men. However, women consume fewer kilojoules per kilogram lean mass and burn fat more preferentially during exercise compared with men (Wu & O'Sullivan, 2011).

According to previous study, there was a significant reduction in fat mass (-0.5 ± 1.3 kg) tendency for a decrease in body fat percentage (-0.4 ± 1.3% body fat) with fish oil supplemental treatment (Noreen *et al*., 2010); a study by researchers at Wake Forest Baptist Medical Center, for every 10 gram increase in soluble fiber eaten per day, visceral fat was reduced by 3.7% over five years (Hairston *et al*., 2011), which supports the results obtained showing that their BMI and body fat percentage were situated at normal category among users based on WHO classification.

Normal BMI and body fat percentage might also be influenced by lifestyle patterns, since 65% of users reported that they are physically active to highly active. Physical activity increases total energy expenditure, which can help people stay in energy balance or even lose weight. In addition, it decreases fat around the waist and total body fat (Hu, 2008).

Association between lipid lowering supplement groups with nutritional and health status

Table 6 depicts the associations among lipid lowering supplement groups relative to the nutritional and health status among supplement users. There were no significant associations found between stress level, depression level, social health category, HDL-c category and BMI category within lipid lowering supplement groups. Furthermore, there were also no significant associations found among diseases category, blood pressure category, TC category, TG category and LDL-c category within lipid lowering supplement groups.

However, there was an association between body fat percentage and lipid lowering supplement groups, χ^2 (1, N = 100) = 12.86, $p < 0.05$. These results are supported by a previous study which indicated that the fatty acids in fish oil, notably EPA and DHA, have an effect on the partitioning of fat between oxidation (fat burning) and storage in the body. Fatty acids in dietary fat not only influences hormonal signaling events, but also have a very strong direct influence on the molecular events that govern gene expression. It has been shown that the fatty acids EPA and DHA from fish oil (by affecting gene expression) inhibit the activities of fat synthesizing (lipogenic) enzymes (Hannah *et al*., 2001), while at the same time stimulating the activities of key enzymes that govern fat oxidation (fat burning) (Desvergne & Wahli, 1999). A study by Couet *et al*. (1997) found that body fat mass reduced with dietary fish oil (0.88 ± 0.16 kg) ($p<0.05$) using dual-energy X-ray absorptiometry.

Table 6. Association between lipid lowering supplement groups with nutritional and health status of supplement users

Variables	Lipid lowering supplement groups						Pearson Chi-square
	Fish oil & Flaxseed oil		Soluble fiber & Phytosterol		Others[a]		
	N	E.C	N	E.C	N	E.C	
Stress level							
Normal	35	36.0	12	12.8	28	26.3	χ^2=0.754
Mild to extremely severe	13	12.0	5	4.3	7	8.8	p = 0.686
Depression level							
Normal	31	31.7	10	11.2	25	23.1	χ^2=0.893
Mild to extremely severe	17	16.3	7	5.8	10	11.9	p = 0.640
Social Health category							
Low & moderate	22	20.2	4	7.1	16	14.7	χ^2=0.287
High	26	27.8	13	9.9	19	20.3	p = 0.238
HDL-c category							
Low & moderate	30	32.6	13	11.6	25	23.8	χ^2=1.417
High	18	15.4	4	5.4	10	11.2	p = 0.492
BMI category							
Underweight & Normal	31	31.2	9	11.1	25	22.8	χ^2=1.726
Overweight & Obese	17	16.8	8	6.0	10	12.3	p = 0.422
Body Fat % category							
Non-obese	42	37.9	8	13.4	29	27.7	χ^2=12.86
Obese	6	10.1	9	3.6	6	7.4	p = 0.002*

Variables	Lipid lowering supplement groups				Pearson Chi-square
	Fish oil & Flaxseed oil		Others[b]		
	N	%	N	%	
Diseases category					
Yes	6	12.5	11	21.2	χ^2=2.235
Not sure	5	10.4	8	15.4	p = 0.327
No	37	77.1	33	63.5	

Variables	Lipid lowering supplement groups				Fischer Exact's Test
	Fish oil & Flaxseed oil		Others[b]		
	N	%	N	%	
Blood pressure category					
Non-hypertension	48	100.0	49	94.2	p=0.244
Hypertension	0	0.0	3	5.8	
TC category					
Normal & Borderline to high	47	97.9	49	94.2	p=0.340
High	1	2.1	3	5.8	
TG category					
Normal & Borderline to high	48	100.0	49	94.2	p=0.244
High & Very high	0	0.0	3	5.8	
LDL-c category					
Optimal to Borderline to high	47	97.9	50	96.2	p=1.000
High	1	2.1	2	3.8	

Notes: Others[a] mean ginkgo biloba, red yeast rice, ginseng, *N. sativa* and honey, soy and other supplements. Others[b] mean soluble fiber, phytosterol, ginkgo biloba, garlic, red yeast rice, ginseng, *N. sativa* and honey, soy and other supplements. Others[a] and Others[b] were different in order to fulfill the conditions of Chi-square and Fischer Exact's test. E.C means expected counts. Statistically significant at p<0.05 by Chi-square test.

Besides fish oil, fiber and soy protein intake tend to show signification association towards body fat percentage. A previous prospective cohort study by Tucker and Thomas (2009) stated for each 1 g increase in total fiber consumed, body fat decreased by 0.25 percentage points ($p<0.01$). According to Guerin-Deremaux *et al.* (2013), body fat decreased significantly with 18 g and 24 g soluble fiber supplementation in 100 overweight adults in China. A previous study found that soy protein intake was associated with improved fat oxidation markers (Morifuji *et al*., 2006). A study of 83 obese men and women by Deibert *et al*. (2004) examined three treatment groups, including two groups following a high-soy-protein, low fat diet. The soy protein group lost more body fat while preserving lean muscle.

These results differ from several studies that showed no significant association with health and nutritional status (NCEP, 2001; Morris *et al*., 1993), but they are broadly consistent with studies from Sacks *et al*., 2006 and Eslick *et al*., 2009. These differences may be due to reasons such as the dose (Racette *et al*., 2009; Guerin-Deremaux *et al.*, 2013), duration (Zhu *et al*., 2014; Allen *et al*., 2007), and bioavailability (Holub & Grebow, 2011; Lawson & Hughes, 1988) of lipid-lowering supplements.

CONCLUSION

This study has identified lipid-lowering supplements (fish oils, ginkgo biloba, garlic, soluble fiber, red yeast rice, phytosterol, ginseng, *N. sativa* and honey, soy, flaxseed oil and others) users had a normal state of mental and social health status and nutritional status in terms of TC and TG, blood pressure for both systolic and diastolic, BMI (for females) and body fat percentage for both males and females. However, it did not influence the HDL-c and LDL-c levels. The second major finding was that there was an association between lipid lowering groups and body fat percentage ($p=0.002$). These findings suggest that in general lipid lowering supplements may have beneficial influence on the mental and social health status, and nutritional status (i.e. TC and TG, blood pressure, body fat percentage). These results must be interpreted with caution as patients do need to seek advice from medical practitioner prior to supplement consumption.

It is unfortunate that the study did not include the duration of supplement consumption among the respondents, which may affect the measurement of supplement effectiveness accurately as some supplements work in long term. An additional uncontrolled factor is the possibility of other factors such as unknown food-drug interaction, genotype, different lifestyle factors and compliance to supplements use and drug, which may influence the findings. Thirdly, the study did not evaluate the lipid profile of respondents before supplementation.

Notwithstanding these limitations, the study suggests that further investigation on nutritional and health status of lipid lowering supplements users by dosage, duration and forms of lipid lowering supplements need to be carried out. Further studies may involve high risk subjects such as hyper-lipidemia, hypertensive or obese patients in a longitudinal study to observe possible changes over a period of time. Unknown food-drug interaction should be investigated to ensure the effectiveness of lipid lowering supplements. Moreover, confounding factors such as socio-demographic, physical activity levels and diet need to be controlled to solely investigate the effectiveness of lipid lowering supplements toward health and nutritional status of subjects. Large randomized controlled trials on mechanisms of lipid lowering supplements could provide more definitive evidence.

In spite of its limitations, the study certainly adds to our understanding of the health and nutritional status of lipid lowering supplement users. This study offers some insight to medical practitioners, dieticians, nutritionists and health-related government. Public will be more self-assured on consuming this kind of supplements and decrease the dependent on lipid lowering drugs which consist of adverse side effects subject to medical approval.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the respondents for their participation and cooperation during the study and research funding from Universiti Malaysia Terengganu.

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