High Consumption of Cooking Oil and Risk of Stroke in Yangon General Hospital

A Senior Thesis Submitted

for partial fulfillment of

Bachelor of Science in Public Health

By

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Abstract

Background: Stroke is preventable by carefully controlling diet and physical activities; however, less attention or priority has been given so far. In Myanmar, stroke is the leading cause of death and an estimated 56,224 or 14.14% of total deaths in Myanmar are from stroke. Therefore, it is important to find out the major risk factors contributing to having stroke.

Objectives: To attain knowledge about incidence of stroke and its main risk factors and to find if there is an association between high consumption of cooking oil and risk of stroke.

Methods: A hospital based case-control study was conducted from July to August 2016 at Yangon General Hospital (YGH) located in Yangon, the capital city of Myanmar. The study population was stroke patients admitted at the Department of Medical Neurology and general patients admitted at the orthopedic ward 1 and 2 of YGH. Two-sample t test, chi-square tests and binary logistic regression were used to investigate the association between a high consumption of cooking oil and risk of stroke.

Results: Overall, after the adjustment of known stroke risk factors such as age, physical activity, family history and other food consumptions, consumption of more than 16 milliliters of cooking oil per day was associated with risk of stroke (OR = 5.658, lower limit: 1.331 and upper limit: 24.058 of 95% CI). Control group who did not consume groundnut oil (OR = 0.228, lower limit: 0.057 and upper limit: 0.913 of 95% CI) and sesame oil (OR = 0.090, lower limit: 0.013 and upper limit: 0.619 of 95%) was less likely to develop stroke.

Conclusion: This study suggests immediate need for further intervention to promote public awareness for rational use of cooking oil across Myanmar for prevention of stroke. Health care providers need to focus more on preventing stroke among people with lower education level and lower income and also to identify other risk factors that influence an increased risk of stroke.

Keywords: Stroke, cooking oil consumption, groundnut oil, sesame oil, food consumption and age.

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1. Introduction

Stroke is one of the leading causes of death worldwide which results in patients suffering from both physical and mental breakdown. It is also one of the major reasons of life-long disabilities and paralysis. According to Gorelick, stroke is one of the major contributors to the high health care costs and decreasing the quality of life (Maghsoudi, 2013).According to World Health Organization (WHO), 15 million people are suffering from stroke worldwide every year. Of these 15 million stroke patients, 6 million would die and another 5 million suffer from permanent disabilities every year ("Stroke Statistics", 2016).

Worldwide, high blood pressure contributes to more than 12.7 million of strokes. Even though the incidence of stroke is declining in developed countries due to interventions to lower blood pressure and reduce smoking, the overall rate of stroke worldwide remains high due to the aging of the population ("Stroke Statistics", 2016).

Urbanization and industrialization are rapidly increasing an epidemiological transition and changes in Asia, resulting people in having unhealthy lifestyles, which promote stroke and other cardiovascular diseases. As a result, Asia is one of the leading continents with the highest rates of stroke mortality and disability-adjusted life year loss (Kinlay, 2015).

One of the studies has shown that fat from the daily diet increases risk of heart diseases and stroke by increasing the activity of Factor VII which causes blood to coagulate. The study also showed that all five different high-fat meals, which are 42 percentage fat mixed with rice, beef, onion, red pepper and corn, cause significant increases in Factor VII ("High-Fat Meal May Raise Risk Of Blood Clotting -- Increasing Heart Attack And Stroke Risk", 1997).

The study done in Denmark also found that olive oil and rapeseed oil also produce the same effects like the other fats. Both oils are monounsaturated fatty acids (MUFA) and have been considered as more heart healthy fats than saturated fats. The results, however, showed

that fats rich in MUFA do not differ from fats rich in polyunsaturated or saturated fatty acids. Both of the oils produce the acute effects on the coagulation factors among Danish men. The report commented that a diet high in saturated fats mainly contained in meat and dairy products can lead to high cholesterol levels in the blood, which can contribute in building up the fatty acids in the body's blood vessels. The obstructions can block blood flow and trigger a heart attack or stroke (American Heart Association, 1997).

Another study also showed that intake of saturated fatty acids (SFA) and monounsaturated fatty acids (MUFA) both in men and women with stroke are significantly higher than controls. The findings of the study indicated that the mean intake of hydrogenated fats, butter, cream, mayonnaise sauce and nuts are higher in men with stroke whilst hydrogenated fats, vegetable oils, cream and mayonnaise sauce are present in women with stroke more than controls (Darvishi, Hariri, & Hajishafiei, 2013).

Although stroke is preventable by carefully controlling diet and physical activities, people give less attention or priority to it. In Myanmar, stroke is the leading cause of death and according to WHO 2014 data, an estimated 56,224 or 14.14% of deaths in Myanmar are from stroke. In Myanmar, stroke rose from approximately 3.9% of all deaths to 6.9% between 1990 and 2010 (Byfield, 2013). In Myanmar, the older people are most at risk of stroke and it results them in early death and a long term disability or paralysis. The health burdens of stroke create negative impact on their family domestic health care expenditure and other social and economic factors (Kyaw & Thu, 2011).

Smoking is also one of the major risk factors of stroke and it increases the risk of heart disease and stroke by two to four times. Due to its important contribution to the risk of stroke, other studies and interventions in Southeast Asia have been done on prevention of non-communicable diseases by controlling tobacco use and smoking (Thakur, J., Narain, J., Garg, R., & Menabde, N., 2011).

However, studies on how to educate people about stroke and how to help them plan their diet by reducing unhealthy fat intake level are yet to be done in Myanmar. Myanmar people consume huge quantity of cooking oil; particularly, groundnut and sesame oil, in their traditional cuisines. Oil crops cover around 20% of the agricultural land of Myanmar. Myanmar is the largest producer of sesame oil, almost 27% of the world production and the fourth producer of the groundnut oil, 4.5% of the world production. Myanmar is the largest producer of sesame seed and sesame oil in the world (Wijnands, 2014).

In Myanmar, almost all seeds and other derived products are consumed domestically. Oils from sesame seeds, groundnuts and sunflower seeds are the main domestic supplied oils in 2011 and other oil crops also supply a minor part. The production as well as the import doubled between 2001 and 2011. Production of rice barn oil and the import of other vegetable oil decreased in that period (Wijnands, 2014).

Sesame oil contains significantly more polyunsaturated fats, which include omega-3 fatty acids but it contains nothing in the way of minerals ("Health Benefits: Sesame Seed Oil Vs. Olive Oil", n.d.).Most of the studies show that the effect of peanuts and peanut oil lower total cholesterol and LDL but do not increase HDL (Weil, 2011). Despite the fact that both sesame oil and peanut oil, which are mostly consumed, lower bad cholesterol, there is still a high incidence rate of stroke among Myanmar people. Though there are several studies done on prevention of smoking and alcohol consumption, which are associated with risk of stroke, studies and interventions to prevent high intake of fat are yet to be done in Myanmar.

In this study, it is hypothesized that a high consumption of cooking oil, high in saturated fat, is associated with a high risk of stroke in Yangon General Hospital. The specific objectives of the study are; **1) To compare the consumption of cooking oil and other potential factors among cases and controls; 2) To determine if high consumption of cooking is a risk factor of having stroke; 3) To help raising awareness about negative**

effect of high consumption of cooking oil (if the findings are significant); and 4) To contribute in improving stroke prevention guidelines as well as dietary and lifestyle guidelines at national level.

2. Methods

2.1. Study Setting

The study was conducted at Yangon General Hospital (YGH) located in Yangon, the capital city of Myanmar. The 115-year-old hospital is a major public hospital as well as the most crowded hospital in Yangon and has been providing medication services to patients from different areas of the country (Darzi, 2016). YGH is a tertiary care teaching hospital with 1500 beds, and it has 3 medical wards and 3 surgical wards. One trauma and orthopedic ward and more than 25 wards and departments for specialties are available for inpatients and emergency services for outpatients. YGH also provides awareness raising programs of prevention for the public such as educational talk, seminars, discussions, and media support through journals, newspapers and TVs (Min, 2016).

2.2. Study Design and Participants

A hospital based case-control study was conducted from July to August, 2016. The study population was stroke patients admitted at the Department of Medical Neurology and general patients admitted at the orthopedic ward 1 and 2 of YGH.

2.3. Sampling Method

Consecutive sampling method was used to select cases. After matching for sex, the first 50 female and male stroke patients were recruited at the Department of Medical Neurology. Their close guardians who spent most of the time with them were asked to give consent for the survey. Purposive sampling method was used for controls selection and the first 50 controls, after matching for sex, were also selected accordingly at the orthopedic ward 1 and 2 of YGH. The case patients who were able to speak were asked for the survey

and the close guardians of those who were not able to speak due to their health conditions were asked for the survey. To avoid double participant recruitment, the names of the participants were recorded during the data collection period.

2.4. Data Collection

A semi-structured questionnaire was developed for survey data collection. In the first five parts of the questionnaire, demographic data, socio-economic data, information on cooking oil consumption, information on daily activities and information about stroke were included. A food frequency questionnaire (FFQ) attained from http://www.srl.cam.ac.uk/epic/epicffq/ffq.pdf was modified according to Myanmar people's daily food consumption and data collection was done by the investigator.

2.5. Data Analyses

SPSS 22.0 Production Mode Facility Evaluation Version was used to analyze data (IBM, 2013). Descriptive statistics such as frequency, percentage, mean and standard deviation were used to analyze selected variables. Independent Samples t test was computed to find mean and standard deviation of some independent variables. Chi-square test and odds ratio (OR) with corresponding 95% confidence intervals (CI) were computed to find an association between independent and dependent variable (stroke). A P-value equal to or less than 0.05 was considered statistically significant. Variables having a P-value equal to or less than 0.05 in the bivariate analysis were subjected into a multivariate analysis to determine factors independently predicting stroke.

2.6. Ethical Consideration

Ethical approval was obtained from the Asian University for Women, Institutional Review Board (IRB). Permission letter was proposed to the Ministry of Health Myanmar through the head of Yangon General Hospital. Approval was obtained to conduct the study after two weeks. Participant information sheet was provided to each of the study participant

and written participant consent form was obtained from each of the study participant. Information of the participants was stored on a password protected laptop. Confidentiality was prioritized and ensured at all levels of the study throughout the research.

3. Results

3.1. Table 1 shows the socio-demographic and economic characteristics of respondents. Among cases, majority of the respondents (54%) were age between 62 and 89 years. Among controls, majority of the respondents (52%) were age between 14 and 42 years. The second largest group among cases and controls (both with 32%) was age between 43 and 61 years. Among cases, Buddhists and Muslims were 94% and 6% respectively. Among controls, 80% were Buddhists, 2% were Hindus, 10% were Muslims, and 8% were Christians. Majority of respondents were married among cases (82%) as well as among controls (68%). In both groups, 92% of respondents were literate. Among cases, 24% of respondents and 22% of respondents attended until primary school and high school respectively. Meanwhile, among controls, 32% of respondents and 28% of them attended middle school and high school respectively. Majority of the respondents among cases was housewife or househusband (42%). Similarly, majority of the respondents among controls was housewife or househusband (34%). In both cases and controls, most of the respondents got the household's main source of income from their family members (78% and 64% respectively). Majority of the respondents among cases (48%) and controls (44%) earned 100000-200000 MMK per month as a whole household.

Table 1: Socio-demographic and economic characteristics of respondents.

Variable	**Category**	**Case N=50 (%)**	**Control N=50 (%)**	**P value**
Age	14-42 yrs 43-61 yrs 62-89 yrs	7 (14) 16 (32) 27 (54)	26 (52) 16 (32) 8 (16)	0.0001*
Religion	Buddhist Hindu	47 (94) 0 (0)	40 (80) 1 (2)	0.030*

	Muslim	3 (6)	5 (10)	
	Christian	0 (0)	4 (8)	
Marital status	Married	41 (82)	34 (68)	0.081
	Divorced	1 (2)	0 (0)	
	Never married	8 (16)	16 (32)	
Literacy	Yes	46 (92)	46 (92)	1.000
	No	4 (8)	4 (8)	
Education level	Primary school	12 (24)	7 (14)	0.919
	Middle school	9 (18)	16 (32)	
	High School	11 (22)	14 (28)	
	University	0 (0)	2 (4)	
	Bachelor	5 (10)	4 (8)	
	Monastery	9 (18)	3 (6)	
	Not applicable	4 (8)	4 (8)	
Occupation	Government service	2 (4)	6 (12)	0.033*
	Business	5 (10)	5 (10)	
	Farmer	5 (10)	6 (12)	
	Laborer	7 (14)	9 (18)	
	Student	0 (0)	5 (10)	
	Housewife/househusband	21 (42)	17 (34)	
	Others	10 (20)	2 (4)	
Main source of income	Themselves	11 (22)	18 (36)	0.186
	Someone else	39 (78)	32 (64)	
Income per month (MMK)	Less than 50000	6 (12)	6 (12)	0.803
	50000-100000	4 (8)	5 (10)	
	100000-200000	24 (48)	22 (44)	
	200000-300000	5 (10)	9 (18)	
	More than 300000	11 (22)	8 (16)	

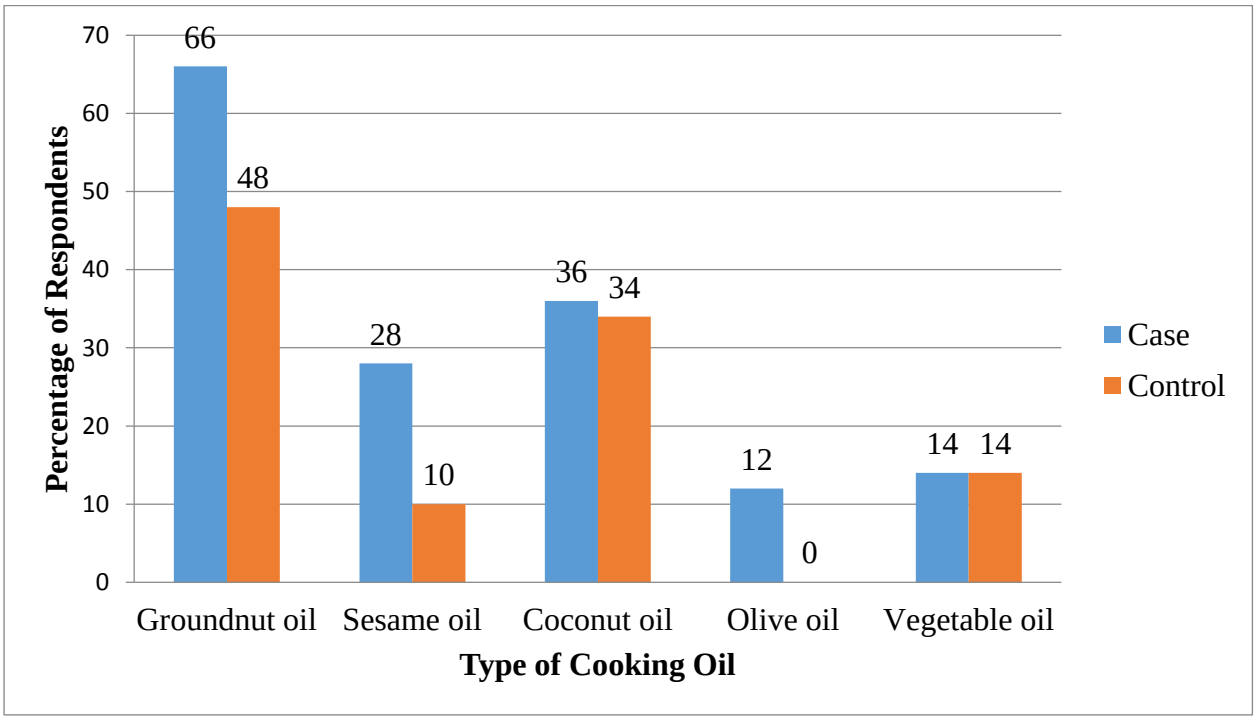
3.2. In Table 2, among cases, the mean age, BMI, amount of cooking oil consumption and cost of cooking oil were 61.48 years, 22.49, 36.32 ml/day and 6218 MMK respectively. Among controls, the mean values of age, BMI, amount of cooking oil consumption and cost of cooking oil were 40.96 years, 20.68, 26.24 ml/day and 5788 MMK respectively.

Table 2: Independent samples test of age, BMI, amount of cooking oil consumption and cost of cooking oil.

Variable	Case (Mean±SD)	Control (Mean±SD)	P value
Age	61.48±16.57	40.96±17.80	0.304
BMI	22.49±3.62	20.68±3.74	0.293
Amount of cooking oil consumption (mL)	36.32±29.68	26.24±17.63	0.010*
Cost of cooking oil (MMK)	6218±3883.12	5788±3787.12	0.592

3.3. Figure 1 provides proportion of respondents who consumed different types of cooking oil. Groundnut oil was consumed the most by 66% of cases and 48% of controls. On the other hand, olive oil was least consumed by 12% of cases and 0% of controls. Sesame oil was consumed by 28% of cases and 10% of controls. While coconut oil was consumed by 36% of cases and 34% of controls, 14% of respondents in both groups consumed vegetable oil.

Figure 1: Percentage of respondents who consume different types of cooking oil in the previous year from the survey time.



3.4. Table 3 provides information on the participants' daily physical activity and knowledge about stroke. Among cases, 34% of respondents did work-out but 66% of them did not do work-out in the past year. Among controls, 32% of respondents did work-out but 68% of them did not do work-out. In both cases and controls, 22% of respondents had knowledge about stroke but 78% of them in both groups did not have knowledge about stroke. Among cases, 36% of respondents had family history while 64% of them did not have family history. Among controls, 8% of respondents had family history whilst 92% of them did not have family history.

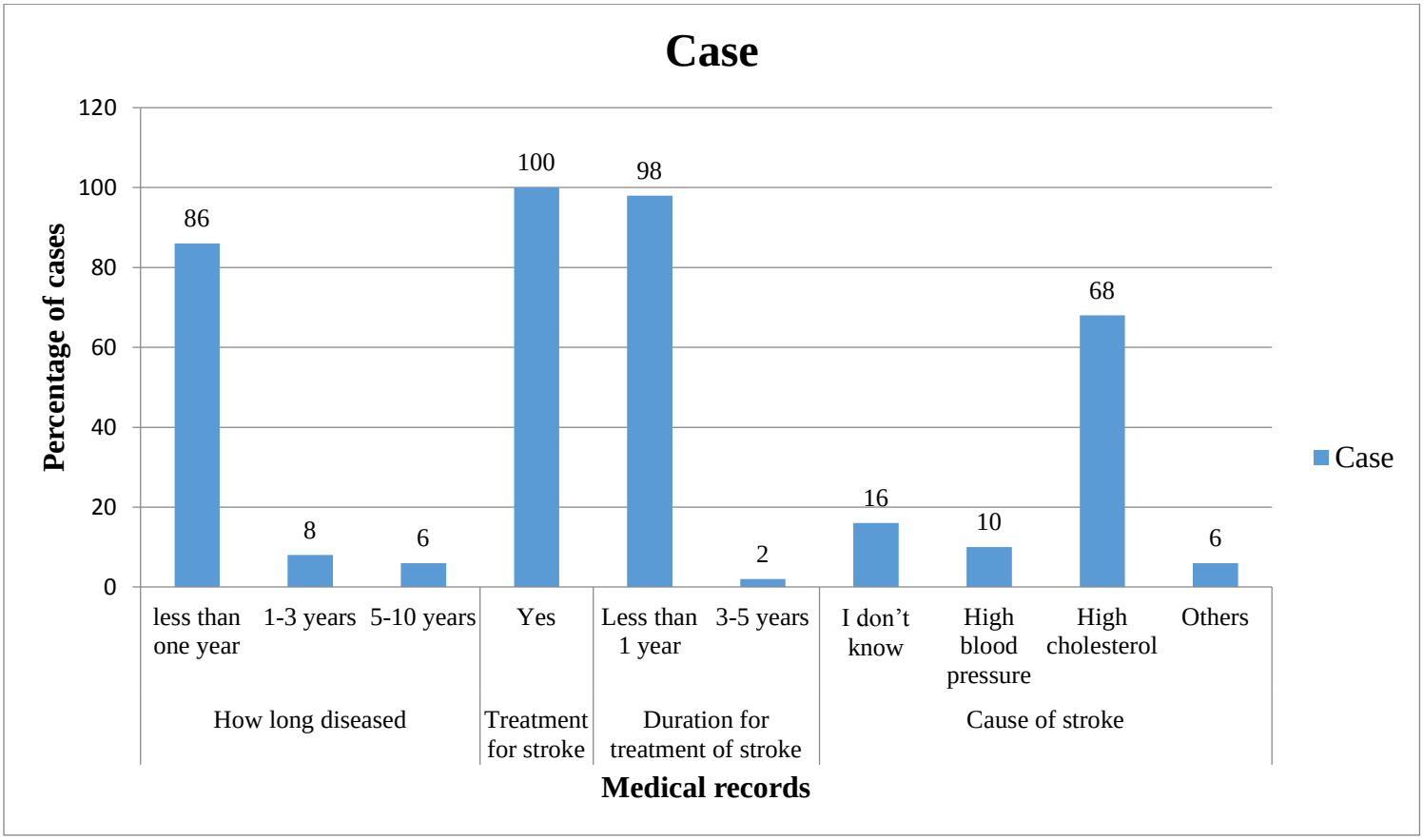
Table 3: Information on physical activity, knowledge and family history of stroke by cases and controls.

Variable	**Category**	**Case N=50 (%)**	**Control N=50 (%)**	**P value**
Daily work-out	Yes No	17 (34) 33 (66)	16 (32) 34 (68)	1.000
How often exercise	1-5 per month 6-10 per month 11-15 per month 16-20 per month >20 per month Not applicable	0 (0) 2 (4) 3 (6) 2 (4) 10 (20) 33 (66)	4 (8) 0 (0) 3 (6) 0 (0) 9 (18) 34 (68)	0.848
Knowledge of stroke	Yes No	11 (22) 39 (78)	11 (22) 39 (78)	1.000
Family history	Yes No	18 (36) 32 (64)	4 (8) 46 (92)	0.001*

3.5. Medical records for cases were mentioned in Figure 2. Among cases, 86%, 8%, and 6% of respondents had stroke less than 1 year, 1-3 years, and 5-10 years, respectively. All of them had been having treatment for stroke and 98% and 2% of them had been having treatment for stroke less than 1 year and 3-5 years respectively. Majority of the respondents among cases (68%) had stroke due to high cholesterol and minority of them (6%) had stroke

due to other factors. Among cases, 10% of them had stroke due to high blood pressure and 16% of them did not know the risk factors.

Figure 2: Clinical information for the case.



3.6. Different types of food consumed by case and control are presented in Table 4. Among cases, 46% of respondents consumed soup but 54% of them did not consume soup. Among controls, 20% of respondents consumed soup but 80% of them did not consume soup. In both groups, majority of the respondents (74% among cases and 52% among controls) never consumed beef in the past year. Among cases, 22% of respondents and 36% of them among controls consumed beef for 1-5 times per month. In both groups, majority of the respondents (38% among cases and 42% among controls) consumed sea food for 1-5 times per month in the past year. Among cases, 32% of respondents and 20% of them among controls never

consumed sea food. In both groups, majority of the respondents (54% among cases and 66% among controls) never consumed instant coffee in the past year. Among cases, 28% of respondents and 12% of them among controls consumed instant coffee for more than 20 times per month in the past year. In both groups, majority of the respondents (70% among cases and 36% among controls) never consumed soft drinks in the past year. Among cases, 22% of respondents and 36% of them among controls consumed soft drinks for 1-5 times per month. In both groups, majority of the respondents (70% among cases and 86% among controls) never consumed tobacco in the past year. Among cases, 30% of respondents and 10% of them among controls consumed tobacco for more than 20 times per month.

Table 4: Information on different types of food consumed by cases and controls.

Variable	**Category**	**Case N=50 (%)**	**Control N=50 (%)**	**P value**
Soup	Yes	23 (46)	10 (20)	0.010*
	No	27 (54)	40 (80)	
Beef	Never	37 (74)	26 (52)	0.013*
	1-5 per month	11 (22)	18 (36)	
	6-10 per month	2 (4)	2 (4)	
	11-15 per month	0 (0)	2 (4)	
	16-20 per month	0 (0)	1 (2)	
	>20 per month	0 (0)	1 (2)	
Seafood	Never	16 (32)	10 (20)	0.030*
	1-5 per month	19 (38)	21 (42)	
	6-10 per month	12 (24)	6 (12)	
	11-15 per month	1 (2)	5 (10)	
	16-20 per month	2 (4)	7 (14)	
	>20 per month	0 (0)	1 (2)	
Instant coffee	Never	27 (54)	33 (66)	0.079
	1-5 per month	7 (14)	7 (14)	
	6-10 per month	1 (2)	1 (2)	
	11-15 per month	0 (0)	3 (6)	
	16-20 per month	1 (2)	0 (0)	
	>20 per month	14 (28)	6 (12)	
Soft drinks	Never	35 (70)	18 (36)	0.005*
	1-5 per month	11 (22)	18 (36)	
	6-10 per month	2 (4)	9 (18)	

	16-20 per month >20 per month	1 (2) 1 (2)	2 (4) 3 (6)	
Tobacco	Never 1-5 per month >20 per month	35 (70) 0 (0) 15 (30)	43 (86) 2 (4) 5 (10)	0.017*

3.7. Information on gravy and fats consumed by cases and controls is shown in Table 5. In both groups, majority of the respondents (40% among cases and 36% among controls) consumed gravy for more than 20 times per month in the past year. In both groups, second largest numbers of the respondents (30% among cases and 22% among controls) consumed gravy for 1-5 times per month. In both groups, majority of the respondents (78% among cases and 72% among controls) never consumed food fried at home but 56% among cases and 52% among controls consumed food fried at home for 1-5 times per month in the past year. Majority of the respondents (56% among cases and 52% among controls) consumed food fried at streets for 1-5 times per month. Second largest numbers of the respondents (28% among cases and 34% of controls) never consumed food fried at streets. In both groups, majority of the respondents (52% among cases and 56% among controls) did not eat meat at all when animal fat is attached to the meat. However, 24% of respondents among cases ate most of the fat attached to the meat while 22% of them ate as little fat as possible. In both groups, majority of the respondents (64% among cases and 70% among controls) rarely consumed table salt. Second largest numbers of respondents (18% among cases and 12% among controls) always consumed table salt in the past year.

Table 5: Information on gravy and fats consumed by cases and controls.

Variables	**Category**	**Case N=50 (%)**	**Control N=50 (%)**	**P value**
Gravy	Never 1-5 per month 6-10 per month 11-15 per month 16-20 per month	7 (14) 15 (30) 3 (6) 2 (4) 3 (6)	6 (12) 11 (22) 5 (10) 5 910) 5 (10)	0.723

	>20 per month	20 (40)	18 (36)	
Food fried at home	Never 1-5 per month 6-10 per month 16-20 per month	39 (78) 10 (20) 1 (2) 0 (0)	36 (72) 13 (26) 0 (0) 1 (2)	0.398
Food fried at streets	Never 1-5 per month 6-10 per month 11-15 per month 16-20 per month >20 per month	14 (28) 28 (56) 4 (8) 1 (2) 2 (4) 1 (2)	17 (34) 26 (52) 3 (6) 2 (4) 1 (2) 1 (2)	0.634
Visible fat on meat	Ate most of the fat Ate some of the fat Ate as little as possible Did not eat meat	12 (24) 2 (4) 10 (20) 26 (52)	4 (8) 7 (14) 11 (22) 28 (56)	0.248
Table salt to food	Always Usually Sometimes Rarely	9 (18) 2 (4) 7 (14) 32 (64)	6 (12) 4 (8) 5 (10) 35 (70)	0.531

3.8. Logistic regression analysis of contributing factors and risk of stroke among cases compared to controls were presented in Table 6. Before and after adjustment, as age increased by one year, the odds of being at risk of stroke increased by 1.06 units and 1.07 units, respectively. The respondents who did not have family history of stroke were less likely to develop stroke (OR = 0.15 before adjustment and 0.07 after adjustment). After adjustment, the respondents who consumed more than 16 milliliters of cooking oil per day were more likely to develop stroke (OR = 5.65). After adjustment, the respondents who did not consume groundnut oil were less likely to develop stroke (OR = 0.22). The respondents who did not consume sesame oil were less likely to have stroke (OR = 0.28 before adjustment and 0.09 after adjustment). Before adjustment, the respondents who consumed some of the fat were less likely to develop stroke (OR = 0.09). Before adjustment, the respondents who consumed soft drinks for 1-5 times (OR = 0.31) and 6-10 times (OR = 0.11) per day were less likely to develop stroke. After adjustment, the respondents who consumed

soft drinks for 1-5 times per month were less likely to develop stroke (OR = 0.14). Before adjustment, the respondents who consumed tobacco for more than 20 times per month were more likely to develop stroke (OR = 3.68).

Table 6: Logistic regression analysis of contributing factors and risk of stroke.

Variables	Unadjusted OR	95% CI		Adjusted OR	95% CI	
		Lower	Upper		Lower	Upper
Age	1.06*	1.03	1.09	1.07*	1.02	1.12
Physical activity						
Yes	Ref					
No	0.91	0.39	2.10	0.66	0.14	3.05
Family history						
Yes	Ref					
No	0.15*	0.04	0.50	0.07*	0.01	0.59
Amount of cooking oil consumption						
≤16	Ref					
>16	1.92	0.86	4.29	5.65*	1.33	24.05
Groundnut oil						
Yes	Ref					
No	0.47	0.21	1.06	0.22*	0.05	0.91
Sesame oil						
Yes	Ref					
No	0.28*	0.09	0.86	0.09*	0.01	0.61
Fats on meat						
Ate most of the fat	Ref					
Ate some of the fat	0.09*	0.01	0.66	0.32	0.02	5.38
Ate as little as possible	0.30	0.07	1.25	1.39	0.12	16.32
Did not eat meat	0.31	0.08	1.08	1.04	0.13	8.33
Salt to food						
Always	Ref					
Usually	0.33	0.04	2.43	0.62	0.03	10.23
Sometimes	0.93	0.19	4.37	0.25	0.01	4.10
Rarely	0.61	0.19	1.90	0.17	0.02	1.18
Soft drinks						
Never	Ref					
1-5 per month	0.31*	0.12	0.80	0.14*	0.02	0.80
6-10 per month	0.11*	0.02	0.58	0.21	0.01	2.52
16-20 per month	0.25	0.02	3.03	0.14	0.01	4.75
>20 per month	0.17	0.01	1.76	0.10	0.01	104.22

Tobacco						
Never	Ref					
1-5 per month	0.01	0.01		0.01	0.01	
>20 per month	3.68*	1.21	11.14	6.31	0.78	50.54

Abbreviations: OR = Odds Ratio, CI = Confidence Interval, p* < 0.05.

4. Discussion

4.1. Major Findings

This study has found that high consumption of more than 16 millilitres of groundnut and sesame oil per day has an increased risk of stroke among cases as compared to controls. After adjustment of other known stroke risk factors including age, physical activity, family history and other food consumptions, consumption of more than 16 millilitres of cooking oil per day was associated with higher risk of stroke. In contrast, control group who did not consume groundnut oil and sesame oil was less likely to develop stroke. The reason could be that groundnut oil is vegetable oil which contains relatively higher saturated fat (5% out of 11% of total fat in one ounce) indicated in the household USDA foods fact sheet. This nutrition fact of peanut oil constitutes that consuming saturated fats, which increase LDL and cholesterol level in the blood, is a risk factor of heart diseases and stroke. On the other hand, sesame oil which contains lower saturated fat (2g out of 14g of total fat in 1 tablespoon) indicated in the household USDA foods fact sheet. Although sesame oil contains less saturated fat, consuming more than enough amounts of mono-saturated fats and unsaturated fats can also increase risk of stroke.

Study done to compare fat intake between stroke and normal population had also proved that Saturated Fatty Acid (SFA) and Mono-saturated Fatty Acid (MSFA) intake of both men and women with stroke were significantly higher than controls, consistent with our results (Darvishi, Hariri, & Hajishafiei, 2013). Another study done in Northern Manhattan, New York also had proved this hypothesis to be true, mentioning that the highest five equal groups of total dietary fat intake have risk of ischemic stroke (Albala, Elkind, & White,

2009). The additional study done on "Dietary intake of key nutrients and subarachnoid haemorrhage: a population-based case-control study in Australasia," had also proved that frequent fat intake was associated with a risk of subarachnoid haemorrhage, specifically among people who had hypertension.

However, these few supporting studies and the present study alone cannot generally conclude since other various studies had also reported negative associations between fats consumption and risk of stroke. One study done on linoleic acid, other fatty acids, and the risk of stroke, had shown that serum linoleic acid was negatively associated with the risk of total stroke, ischemic stroke and particularly lacunar infarction. In their findings, they had mentioned that saturated fatty acids were positively associated with the risk of total stroke, ischemic stroke, and lacunar infarction before adjustment. However, after the adjustment for linoleic and mono-saturated fatty acids, the findings had become insignificant (Iso, Sato, & Umemura, 2002). Similarly, another meta-analysis study, which reviewed other eight prospective studies, had also found that there was no association between dietary saturated fat and stroke even after adjustment with total energy which was thought to be relevant to evaluate nutrient-disease relations (Tarino, Sun, & Hu, 2010). Therefore, the present study is further required to be emphasized and reevaluated with sufficient participants in different places.

4.2. Age

One of the contributing factors to the risk of stroke was an increasing age. Before and even after the adjustment of all matching variables, as age increased by one year, the odds of being at risk of stroke increased by 1.067 units and 1.075 units, respectively. Focusing on longitudinal studies, one study done on influence of age and risk of stroke had proved an association between increasing age and risk of stroke. It discussed that the incidence doubled with each 10 years after the age of 45 years and over 70% of all strokes occur above the age

of 65 (Hayes, 2011). The present study also found that the mean age of stroke patients was 61.48 years.

However, one study had found that both younger black and white patients aged between 20 and 54 had an increased incidence of ischemic stroke in 2005, compared to earlier studies. It also found that incidence rates in the oldest age groups were declining (Kissela, Khoury, & Alwell, 2012). However, the mean age in control group in the present study was 40.96 years. Consistent with the current study, another cohort study had also found that age of 30 to 50 years had a low risk of stroke (Melgaard, Rasmussen, & Skjoth, 2014).

4.3. Family history

Another contributing risk factor of stroke was family history. Before and even after the adjustment of all matching variables, people who did not have family history of stroke were less likely to develop stroke. Genetic factors are uncontrollable and they play a significant role in NCDs, specifically stroke. People with a family history of stroke are more likely to share similar environments and lifestyles that increase their risk. The risk of having stroke can increase even more when heredity combines with unhealthy lifestyle choices, such as eating unhealthy diets and smoking cigarettes (CDC, 2017). Therefore the present study proves that families who share similar lifestyles and eating habits such as consuming a huge amount of cooking oil have an increased risk of stroke.

4.4. Soft drinks

Another contributing risk factor was interestingly associated with risk of stroke. Before the adjustment of the matching variables, it was found that people who consumed soft drinks for 1-5 times and 6-10 times per month were more likely to develop stroke. A nine-year study had suggested that drinking soda regularly may raise the risk of stroke and heart disease (Laino, 2011). Another study done on diet soda and heart disease had proven an association between daily consumption of diet sodas and stroke or heart disease or

cardiovascular diseases. The study was a 10 year long follow up study on 2,500 New York residents. At the beginning of the study, participants were over 40 years old and had never had stroke. At the end of 10 years, the regular diet soda drinkers developed stroke, heart disease, and type 2 diabetes, along with other risk factors such high blood pressure, high blood sugar, excess body fat and abnormal cholesterol levels (Ferrari, 2012).

4.5. Tobacco

One of the other major findings was that tobacco consumption had an association with stroke risk. Before adjustment of the known stroke risk factors and the matching variables, the respondents who consumed tobacco more than 20 times per month were more likely to develop stroke. One of the studies had summarized the articles after reviewing and found that smoking and both ischemic and intracerebral hemorrhage stroke are significantly associated regardless of different ethnicities and populations from different countries (Shah & Cole, 2010). Another prospective cohort study had found that smokers with an increased amount of cigarettes per day have a risk of total hemorrhagic stroke, intracerebral hemorrhage, subarachnoid hemorrhage and ischemic stroke (Kurth, Kase, & Berger, 2003). The present study also found that smoking or consuming tobacco is an established risk factor of stroke and it has a major impact on developing stroke.

4.6. Socio-demographic and economic findings

Table 2 shows the socio-demographic and economic characteristics of the respondents. Interestingly, religion and occupation have an association with stroke incidence. Majority of cases (54%) were aged between 62-89 years while control group (52%) was aged between 14-42 years. The findings show that age has a very significant effect on an increased risk of stroke. In both groups, majority of the respondents were Buddhists (cases = 94% and controls = 80%, 95% CI: 0.030). However, it can be noted that religion has no association with stroke no matter what eating habits were different according to their religions since most

of the respondents in both groups were Buddhists. In both groups, majority of the respondents were housewives or househusbands (cases = 42% and controls = 34%, 95% CI: 0.033). This does not explain that occupation has a significant association with stroke risk as most of them in both groups were in that category. However, it can be explained that as both groups were doing house work and probably having sedentary life styles, they all had physical inactivity related diseases and were hospitalized at the time. Other variables such as marital status, literacy, education level, main source of income and income per month (MMK) had insignificant associations with stroke risk since both groups equally share the same distributions.

4.7. Different types of cooking oil

As mentioned above in the major findings section, consuming groundnut oil and sesame oil had associations with an increased risk of stroke despite the fact that all of the oils are vegetable oils. It can be explained that consuming more than enough amounts of fats in the form of cooking oils increase stroke risk. Compared to control group (groundnut = 48%, sesame = 10%, coconut = 34%, olive = 0% and vegetable oil = 14%), cases consumed more cooking oils (groundnut = 66%, sesame = 28%, coconut = 34%, olive = 12% and vegetable oil = 14%). However, other vegetable oils were equally consumed by both groups. Interestingly, while 12% of the respondents in cases consumed olive oil, 0% of them in control group consumed olive oil. The findings have proved that olive oil has a major impact on risk of stroke. Inconsistent with the present study, most of the studies in the past have proved that olive oil consumption has a major impact on lower risk of stroke. One of the follow up studies had shown that olive oil intake was inversely associated with risk of cardiovascular diseases (Guasch-Ferre, Hu, & Martinez-Gonzalez, 2014).

4.8. Physical activity and knowledge of stroke

The findings in Table 3 show that physical inactivity and knowledge of stroke in both groups share equal distributions. While 66% of cases did not have physical activity, 68% of control group did not do any exercises. One prospective cohort study found that moderate to heavy physical activity was associated with a decreased risk of ischemic stroke while light activity was not (Willey, Moon, & Paik, 2009). The reason for having insignificant association in the present study could be due to small sample size. Similarly, 78% of the respondents in each group did not have knowledge of stroke. The reasons for these two insignificant findings could be that both groups were patients at hospital and suffering from different cardiovascular diseases and NCDs which had an association with physical inactivity and lack of knowledge.

4.9. Clinical information for the case

Figure 2 mentions medical records of cases and most of the respondents (86%) had stroke less than one year which shows the incidence rate at YGH. Prevalence of stroke among patients who were hospitalized during the survey time was 14% and they were having stroke for 1-10 years. Most of them (98%) were having treatment less than one year and 2% were having the treatment for 3-5 years. Most of the patients with stroke (68%) were told that their disease was due to high cholesterol. In the Myanmar: WHO statistical profile, it was mentioned that stroke was the leading cause of death and killed 56.2 thousand people in 2012. The present study was the case-control hospital based study and we learned that the public hospital like YGH had lack of facilities and medical services due to insufficient budget and lack of health promotion services.

However, one study done in hospitals in Yangon had shown that doctors who graduated before 2000 did not use the evidence-based guidelines while the ones who graduated after 2000 used those guidelines. They rather practiced extensive use of costly

neuro-protective drugs which had no proven effect and pharmaceutical industries are primary influence for treatment and practice in those hospitals. The study discussed that lack of resources were not the main problem but public health education, changes of attitudes and clinical evidence were more important focuses to prevent stroke and overcome the burden of stroke in Myanmar (Kyaw & Thu, 2016).

4.10. Different types of food

Table 4 shows different types of food consumed by both groups and the findings show associations between consuming tobacco or soft drinks and an increased risk of stroke, which were discussed in major findings section. Interestingly, both groups (54% of cases and 80% of controls) did not consume soup. Cases (46%) consumed more soup than control group (20%). Myanmar soup cuisines usually contain a lot of oil and the oil even can be seen on the surface of the soup. The soups are not just boiled vegetables without oil and it thus could be one of the reasons why consuming more soups in cases were associated with an increased risk of stroke.

Beef consumption for 1-5 times per month in both groups (74% of cases and 52% of controls) had an association with an increased risk of stroke. One meat-analysis study observed on 6 prospective studies had shown that red meat consumption had a significant association with total stroke and ischemic stroke. It also said that consuming fresh red meat, processed meat and total red meat for one time per day was positively associated with risk of stroke (Kaluza, Wolk, & Larsson, 2012). The present study however shows that the respondents (22% of cases and 36% of controls) consumed beef only 1-5 times per month has less risk of stroke. The control group even consumed more than cases and further assessments, therefore, need to be done with sufficient participants.

4.11. Gravy, fats and table salt consumption

Table 6 contains certain diets which were considered to be associated with stroke. However, none of the diets had a significant association with stroke. Myanmar cuisine usually contains a lot of fats in the form of cooking oil and most of the respondents (40% of cases and 36% of controls) consumed gravy more than 20 times per month. While majority of the respondents (78% of cases and 72% of controls) never consumed crispy food fried at home, majority of them (56% of cases and 52% of controls) consumed crispy food fried from street vendors. Street foods were fried in oil which was used repeatedly; however, the findings had no association with stroke, surprisingly. The reasons could be the equal percentages of distribution in both groups and small sample size. Visible fat on meat and table salt to food consumption also had an insignificant association with stroke. The percentages of distributions were equally shared in both groups. The first reason could be that case group had already consumed a larger amount of cooking oil than control group as mentioned in major findings section. The second reason could be the case group was already consuming salty food without the need of adding table salt. As mentioned in Figure 2, only 10% of the respondents were having stroke due to hypertension. The present study, therefore, did not find an association between stroke and added table salt.

5. Conclusion

This study shows that cooking oil consumption is considered to be an unhealthy diet consumption which is one of the vital serious risk factors for stroke, which is a serious and major health problem across Myanmar. Both cases and control group have more than one risk factor which is associated with NCDs. The present study also indicates that there are lower education level and lower income in both groups that result them in having unhealthy life styles.

However, some limitations in the present study are to be considered for interpretation of our study findings and further studies. As per nature of the data collection, there could be a recall bias for the previous year's food consumption provided by the guardians of stroke patients. Different types of stroke were not classified. Major potential bias might have also occurred when selecting a control group, for example age of the controls was significantly lower than the cases. Small sample size also might have limited the estimates to become statistically significant. The current study was conducted entirely within one hospital; however, both cases and controls were from different areas of the country. Despite that, having one to two participants from same geographic locations is not representative. Therefore, generalizability to other hospitals and rural areas in the country may not be possible.

6. Recommendations

1. To prevent stroke among lower income people, public health knowledge and education on stroke should be contributed at community level through media, local health organizations and street notices.
2. To reduce cooking oil consumption, higher tax should be exposed on both local products and imported goods with an assistance of government.
3. To improve medical facilities and services, government should increase expenditure in health sector of the country, planning sufficient, efficient and sustainable finance.
4. To enhance the elderly health, health promotion programs through daily work-out, yoga and aerobic dance should be intervened.
5. Further studies need to be done to get to implement preventive strategies and the government is responsible to reach out those strategies to rural areas as well.

Therefore, this study suggests immediate need for further intervention to promote public health knowledge and education on stroke and cooking oil consumption across

Myanmar. Health care providers need to focus more on preventing stroke among people with lower education level and lower income and also to identify other risk factors that influence an increased risk of stroke.

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Appendix – 1

Participant Consent Form

Study title: High Consumption of Cooking Oil and Risk of Stroke among Myanmar Population in Yangon

Lead investigator: Mya Yun Hlwar

Declaration by participant:

I have read and I understand the Participant Information Sheet. I have had the opportunity to ask questions and I am satisfied with the answers I have received.

I freely agree to participate in this study and understand that I can terminate my participation at any point during the study without any adverse consequences. I reserve the right to refuse to answer any question I do not want to answer.

I have been given a copy of the Participant Information Sheet and Consent Form to keep.

Participant's name:

Signature:	Date:

Declaration by member of research team:

I have given a verbal explanation of the research project to the participant, and have answered the participant's questions about it.

I believe that the participant understands the study and has given informed consent to participate.

Researcher's name: Mya Yun Hlwar

Signature:	Date: 2016/…../…..

Hi!

- I am going to ask you some questions related to background information about you, especially what you eat.
- Please answer these questions even if you do not consider yourself to be a person with stroke.
- Take some time to recall your memories and answer as much as you remember.

Thank you so much for your time and your great help.

High Consumption of Cooking Oil and Risk of Stroke among Myanmar Population

Questionnaire **Serial No…….**

Question	**Response**	**Codes**
I.	**General Information**	
1. Name		
2. Age	……<18 ……19-38 ……39-58 ……59-78 ……>79	
3. Gender	……Male ……Female	
4. Height	……cm	
5. Weight	…… kg	
6. Religion	……Buddhist ……Hindu ……Muslim ……Christian ……Other, specify ……..	
7. Marital status	……Married ……Widowed ……Divorced ……Separated ……Never married ……Not married, living with partner	
8. Are you able to read?	…..Yes ….. No (If No, skip to question 10)	
9. What is the highest grade level	……Primary School	

you have completed?	……Middle School ……High School ……University ……Bachelor ……Master ……PhD	
10. Location/address	……... ……	
II. Family socio-economic information		
11. Occupation	……Service (Government) ……Business ……Day Laborer ……Farmer ……Other, specify ……	
12. What is the main source of income in your family?	……Themselves ……Someone else	
13. How much money is generated from main source of income in your family per month?	……50000-100000 MMK ……100000-200000 MMK ……200000-300000 MMK ……> 300000 MMK	
14. Does your family own house?	……Yes ……No	
III. Information on Cooking Oil Consumption		
15. What type of cooking oil do you consume? (Multiple responses are possible)	……Groundnut oil ……Sesame oil ……Copra oil ……Olive oil ……Vegetable oil ……Other, specify ……..	
16. Amount of cooking oil you consume per day	..... ml	
17. What type of cooking style do you prefer? (Multiple responses are possible)	……Boiled ……Cooked ……Fried ……Grilled ……Soup ……Salad	

	……Other, specify ……	
18. Do you have knowledge about stroke and its risk factors?	……Yes ……No	
19. How much do you spend for buying cooking oil that you consume per month?	……MMK	
IV. Information on Daily Activities		
20. Do you work out?	……Yes ……No (If No, skip to question 22)	
21. How often do you do exercise?	……Never or less than once/month ……1-5 per month ……6-10 per month ……11-15 per month ……16-20 per month ……More than 20 per month	
V. Information about Stroke		
22. How long has it been since you were first diagnosed? **Incidence rate**	……< 1 year ……1-3 years ……3-5 years ……5-10 years ……> 10 years	
23. Does your family have history of stroke?	……Yes ……No	
24. Do you get treatment for stroke?	……Yes ……No	
25. How long have you been getting the treatment for stroke?	…….Months	
26. What is the cause which was told to you?	……I don't know ……Diabetes ……High blood pressure ……High cholesterol ……Obesity ……Physical inactivity ……Diet ……Genetics ……Other, specify ……	
Your Diet Last Year		

VI. Meat and Fish (Medium Serving)		
27. Beef: roast, curry, fried, soup	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
28. Pork: roast, curry, fried, soup	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
29. Chicken: roast, curry, fried, soup	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
30. Mutton: roast, curry, fried, soup	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
31. Fish: roast, curry, fried, soup	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
32. Seafood: roast, curry, fried, soup	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
VII. Dairy Products and Fats		
33. Cheese	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month	

	…...More than 20 per month	
34. Yogurt (cup)	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
35. Milk (cup)	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
36. Salad cream, mayonnaise (teaspoon)	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
37. Butter (teaspoon)	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
38. Eggs as boiled, fried, scrambled, etc. (one)	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
VIII. **Sweets and Snacks (MS)**		
39. Sweet biscuits (one)	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
40. Cakes (one slice or piece)	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month	

	…...More than 20 per month	
41. Puddings (one piece)	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
42. Ice cream	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
43. Chocolates	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
44. Sweets, toffies, etc.	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
45. Sugar added to tea, coffee (teaspoon)	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
46. Crisps or other packet snacks	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
47. Peanuts or other nuts	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	

48. Jam, honey (teaspoon)	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
49. Peanut butter (teaspoon)	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
IX. Drinks		
50. Tea (cup)	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
51. Instant coffee (cup)	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
52. Coffee whitener, e.g. coffee-mate (teaspoon)	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
53. Cocoa, hot chocolate (cup)	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
54. Horlicks, Ovaltine (cup)	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	

55. Wine (glass)	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
56. Beer (one tin)	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
57. Whisky, vodka (single)	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
58. Soft drinks, e.g. Coca cola, Pepsi (glass)	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
X. Gravy and Fats		
59. Gravy (tablespoon)	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
60. How often did you eat food that was fried at home?	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
61. How often did you eat fried food away from home?	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	

62. What did you do with visible fat on your meat?	…..Ate most of the fat ……Ate some of the fat …...Ate as little as possible …….Did not eat meat	
63. How often did you add salt to any food at the table?	…..Always …..Usually .….Sometimes ……Rarely …...Never	
XI. Drugs		
64. Tobacco	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
65. Cigarettes	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	
66. Drugs	…...Never or less than once/month …...1-5 per month …...6-10 per month …...11-15 per month …...16-20 per month …...More than 20 per month	

Thank you. Your help is greatly appreciated.