# ORIGINAL ARTICLES

# Association of Hyperlipidaemia with Vascular Dementia among Stroke Patients Attending a Tertiary Level Hospital in Bangladesh

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**Abstract:**

*Background: Stroke is a major cause of physical disability in the elderly and the second most common cause of dementia. The prevalence of Alhzeimer's dementia is increasing in western societies. But vascular dementia (VaD) is increasing in developing countries like Bangladesh and in Japan, because of the decline in mortality after stroke and aging of population. Conflicting data shows that hyperlipidaemia, a modifiable risk factor for ischemic stroke is associated with a higher risk of vascular dementia. Objective: The objective of this study was to evaluate association of hyperlipidaemia with vascular dementia. Method: It was a cross-sectional descriptive study conducted in the Department of Neurology, Bangabandhu Sheikh Mujib Medical University, Shahbag, Dhaka from August 2014 to November, 2015. All stroke patients above 18 years of age and both sexes, attending the department of Neurology, Bangabandhu Sheikh Mujib Medical University, Dhaka presenting at least 3 months after stroke were the study population. Patients attending to the above mentioned hospital and after meeting the inclusion and exclusion criteria a purposive sampling technique were applied for selecting cases. Total 73 cases were evaluated. These patients were examined by MMSE for evidence of dementia. Severity and risk factors of vascular dementia were assessed. Serum fasting lipid profile was estimated in all cases and evaluated their association with VaD. Results: In this study it was observed that most of the stroke patients and VaD patients were in the age group of 5th and 6th decade. Among stroke patients it was 17(23.3%) and 31(42.5%) and among VaD patients it was 10(25.6%) and 18 (46.6%). Male outnumbered female (in stroke male-63%, Female-37%; in VaD male-59%, Female 41%). In this study out of 73 patients 40(54.8%) were smoker, 67(91.8%) had hyperlipidemia, 54(74%) had hypertension, 35(47.9%) had diabetes mellitus, 15 (20.5%) had IHD, 64(87.7%) had ischemic stroke, 9(12.3%) had hemorrhagic stroke, 25(34.25%) had recurrent stroke. Most of the patients were house-wife 16((21.9%) and read upto primary level 22 (30%). Out of 73 stroke patients 39(53.4%) had VaD. Of them 12(30.8%) had mild, 16(41%) had moderate and 11(28.2%) had severe dementia. Again out of 39 VaD patients 38(97.4%) had history of ischemic stroke and 1(2.6%) had history of hemorrhagic stroke who was moderately demented. Among VaD and non-vascular dementia patients the mean S. total cholesterol, S. triglyceride, S. LDL-C and S.HDL-C were 185.35±44.07, 149.82±57.05, 133.58±44.53, 31.07±11.16 (mg/dl) and 178.70±48.40, 151.35±76.12, 116.48±42.39, 33.61±11.82 (mg/dl) respectively. Conclusion-: In this study there is a non-significant positive association with high S. total cholesterol, high S. LDL-C, Low S. HDL-C but not with S. triglyceride. So, we can conclude that hyperlipidemia has weak association with VaD.*

*Key words : Stroke, Vascular dementia, hyperlipidemia.*

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## Introduction :

Throughout the whole world, stroke is a major cause of physical disability in the elderly and the second most common cause of dementia behind Alzheimer's disease[1].Vascular dementia (VaD) is defined as permanent cognitive impairment produced by vascular damage to the brain[2]. In western countries among dementia cases over the age of 65, 25-33% are of vascular dementia. It is more in developing countries like ours and in Japan[3]. The diagnostic criteria for vascular dementia includes, documented intellectual loss, definite vascular damage to the brain, a relationship in time between the occurrence of strokes and the appearance of intellectual symptoms. In some community-based studies it is found that the prevalence of dementia in people with a history of stroke is about 30% (3.5-5.8 times higher than in those who have not had stroke)[4,5].In hospital based studies, the prevalence of Vascular dementia (VaD) ranges from 5.9 to 32%[6-10]. In a community-based study done over 25years, the cumulative incidence of VaD was 7% after 1 year, 10% after 3 years, 15% after 5 years, 23% after 10 years and 48% after 25 years[11].The risk of VaD and its severity are not influenced by the type of stroke (ischemic or hemorrhagic)[12-14]. Patient related variables associated with increased risk of VaD are increasing age[6-10], low education level, pre-stroke cognitive decline without dementia, high blood pressure [15], diabetes mellitus[13]; atrial fibrillation, myocardial infarction[16], epileptic seizures, sepsis, cardiac arrhythmias, congestive heart failure, silent cerebral infarcts, and white matter changes. Still there is no cure for VaD. So, the treatment for vascular dementia is prevention. Most vascular damages to the brain can be avoided through control of blood pressure, lipids, heart disease, obesity, diabetes mellitus, smoking cessation and regulation of heart rhythm. The medications presently available for Alzheimer's disease (AD) are not effective for patients with vascular dementia. Vascular dementia can be distinguished from other dementias through careful attention to clinical history and neurological examination. The clinical presentation of VaD may differ from AD because VaD patients may have stair-step progression, focal neurological deficits and vascular damage on brain imaging. The Lewy body dementia patients frequently present with early hallucinations while the VaD patient usually demonstrate intellectual decline. The Lewy body dementia patient has extrapyramidal symptoms while the VaD patients have focal neurological deficits. Alzheimer's and frontal lobe dementias rarely manifest with focal neurological signs or evidence of extensive stroke on brain imaging.

The prevalence of vascular dementia is increasing in western societies and also in developing countries like Bangladesh. Conflicting data show that hyperlipidemia, a modifiable risk factor for stroke is associated with a higher risk of vascular dementia. Reduced high density lipoprotein cholesterol (HDL-C)[17,18] and apolipoprotien A-1 levels [19], as well as increased levels of lipoprotein (a)[19], have been observed in vascular dementia in some but not in all studies [20,21]. Contradictory results have been found in studies relating to total cholesterol [22,23], HDL-C [19,24] and LDL-C [22,24] levels with VaD. The present study was done to evaluate the association of hyperlipidemia in a group of patients with VaD. Objective of the study was to evaluate association of hyperlipidemia with vascular dementia 3 months after stroke by Mini Mental State Examination (MMSE).

## Methodology:

It was a cross-sectional descriptive study conducted in the department of Neurology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Shahbag, Dhaka, from August 2014 to November 2015. All stroke patients above 18 years of age and both sexes presenting at least 3 months after stroke were the study population. Patients attending to the above mentioned hospital and after meeting the inclusion and exclusion criteria a purposive sampling technique was applied for selecting the cases.

## Selection criteria:

**Inclusion criteria:**
All patients clinically diagnosed first or recurrent stroke (Ischemic or hemorrhagic) confirmed by CT/MRI scan presented with at least 3 months after stroke and patients with stroke age 18 years and above of both sexes.

**Exclusion criteria:**

Patients of age less than 18 years, having pre-existing dementia, on lipid lowering medications, severe neuropsychiatric disorders (schizophrenia, major depressive disorder, alcohol or drug abuser etc), advanced medical conditions (acute myocardial infarction, left ventricular failure, end stage renal failure, malignancy etc), metabolic and toxic states resembling stroke, severe communication difficulties (severe aphasia, blindness, deafness etc) and patient unwilling to participate in the study

**Data collection tools and procedure**

The suspected cases of ischemic and hemorrhagic stroke were identified on the basis of history, clinical examination and findings of CT scan or MRI scan of brain. The following information's were collected from each patient: age, sex, occupation, educational status, detailed history of stroke, hypertension, diabetes mellitus, coronary artery disease, family history of stroke or dementia, current or previous history of smoking, alcohol consumption, tobacco chewing, dietary history and others. Examination findings including hemiparesis/monoparessis, dysphasia, plantar response, pulse, BP, carotid bruit, cardiac murmur were noted. Investigations like serum lipid profile (fasting), blood sugar, serum creatinine, Serum electrolytes, ECG, Chest X-ray, echocardiogram and related investigations were also done. Total 73 cases were included in the study. Patients with scores 24 or lower on MMSE considered as demented. Severity and risk factors of dementia (association with hyperlipidemia) were assessed with types of stroke, location of stroke (lesion), 1st or recurrent strokes etc.

**Statistical analyses:**

Data were collected in a pre-designed questionnaire. Data processing work consists of registration schedules, editing, computerization, preparation of tables and figures, analyzing and matching of data. Patients were divided into 2 groups according to the presence or absence of VaD and hyperlipidemia. Data analysis was done by using SPSS (Statistical Package for Social Science) software for windows version 18. Scatter plots were done to evaluate association between hyperlipidemia (total cholesterol, LDL-c, HDL-c and TG) and Vascular dementia. The horizontal axis (X-axis) represents lipids and vertical axis (Y-axis) represents vascular dementia.

**Results & observations:**

**Table-I**
*Distribution of patients according to age (n=73)*

| Age | Frequency | Percentage |
|---|---|---|
| ≤ 40 | 3 | 4.1 |
| 41- 50 | 7 | 9.6 |
| 51 - 60 | 17 | 23.3 |
| 61 -70 | 31 | 42.5 |
| 71 - 80 | 10 | 13.7 |
| >80 | 5 | 6.9 |
| Total | 73 | 100.0 |

Table I. shows distribution of patients according to age. Most of the patients were above 50 years old. Maximum 31 (42.5%) patients were in age group of 61-70 years followed by 17 (23.3%), and 10 (13.7%), in age of group 51 – 60 years, and 71 – 80 years, respectively.

**Table-II**
*Distribution of patients according to gender (n=73)*

| Gender | Frequency | Percentage |
|---|---|---|
| Male | 46 | 63.0 |
| Female | 27 | 37.0 |
| Total | 73 | 100.0 |

Table II.shows distribution of patients according to gender. Male 46(63%) were predominant than female 27(37%). Male female ratio was 1.7:1.

**Table-III**
*Distribution of patients according to educational status (n=73)*

| Education | Frequency | Percentage |
|---|---|---|
| Illiterate | 9 | 12.3 |
| Primary | 22 | 30.1 |
| Secondary | 21 | 28.8 |
| Higher secondary | 14 | 19.2 |
| Graduate and above | 7 | 9.6 |
| Total | 73 | 100.0 |

Table III. shows distribution of patients according to educational status. Maximum 22 (30.1%) patients completed their primary education followed by 21 (28.8%) and 14 (19.2%) completed their secondary and higher secondary education respectively.

**Table-IV**
*Distribution of patients according to occupation (n=73)*

| Occupation | Frequency | Percentage |
|---|---|---|
| Housewife | 16 | 21.9 |
| Service holder | 13 | 17.8 |
| Business | 4 | 5.5 |
| Others | 40 | 54.8 |
| Total | 73 | 100.0 |

Table IV.shows distribution of patients according to their occupation. Sixteen (21.9%) patients were housewife, 13 (17.8%) were service holder, and 40 (54.8%) patients had miscellaneous occupation.

**Table-V**
*Distribution of patients according to weakness of part of the body (hemiplegia) (n=73)*

| Weakness of part of the body (hemiplegia) | Frequency | Percentage |
|---|---|---|
| Yes | 60 | 82.2 |
| Right | 12 | 16.40 |
| Left | 22 | 30.13 |
| Bilateral | 26 | 35.61 |
| No | 13 | 17.8 |
| Total | 73 | 100.0 |

Table V.shows distribution of patients according to weakness of part of the body (hemiplegia). Sixty (82.2%) patients had weakness of the body. Of them 26 (35.6%) patients had weakness in both side of the body, 22 (30.1%) had weakness in the left side of the body and 12 (16.4%) had weakness in the right side of the body.

**Table-VI**
*Distribution of patients according to relevant past history (n=73)*

| Vascular risk factors | Frequency | Percentage |
|---|---|---|
| Stroke | 73 | 100 |
| Ischemic | 64 | 87.7 |
| Haemorrhagic | 09 | 12.3 |
| Hyperlipidaemia | 67 | 91.8 |
| HTN | 54 | 74.0 |
| DM | 35 | 47.9 |
| IHD | 15 | 20.5 |
| Recurrent Stroke | 25 | 34.25 |

Table VI. shows relevant past history of the patients. Sixty four (87.7%) patients had ischemic stroke and 9 (12.3%) patients had hemorrhagic stroke. Hyperlipidemia was present in 67 (91.8%) patients; HTN, DM and IHD were present in 54 (74.0%), 35 (47.9%) and 15 (20.5%) patients respectively. History of recurrent stroke was present in 25(34.25%) cases.

**Table VII**
*Distribution of patients according to smoking habit (n=73)*

| Smoking habit | Frequency | Percentage |
|---|---|---|
| Non-smoker | 33 | 45.2 |
| Ex-smoker | 31 | 42.5 |
| Smoker | 9 | 12.3 |
| Total | 73 | 100.0 |

Table VII. shows distribution of patients according to smoking habit. Nine (12.3%) patients were smoker, 31 (42.5%) patients were ex-smoker and 33 (45.2%) patients were non-smoker.

**Table-VIII**
*Distribution of patients according to family history of stroke and dementia (n=73)*

| Family history | Yes n (%) | No n (%) |
|---|---|---|
| Stroke | 15(20.55%) | 58 (79.45%) |
| Dementia | 2 (2.74%) | 71 (97.26%) |

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Table VIII. shows distribution of patients according to family history of stroke and dementia. Positive family history of stroke was present in only 15 (20.55%) cases and dementia in only 2(2.74%) cases.

Table IX: shows distribution of patients according to hyperlipidemia in stroke patients with VaD and without. Among 67 hyperlipidemia patients 37 (55.2%) patients had stroke with VaD and 30 (44.8%) patients had stroke without VaD.

**Table IX**

*Distribution of patients according to hyperlipidemia in stroke patients with VaD (n-39) and without VaD (n=34)*

|  | Hyperlipidaemia | | Total |
|---|---|---|---|
|  | Yes | No |  |
| Stroke with VaD (n-39) | 37(55.2%) | 2(43.3%) | 39 (53.4%) |
| Stroke without VaD (n-34) | 30 (44.8%) | 4 (66.7) | 34 (46.6) |
| Total | 67 (100.0) | 6 (100.0) | 73 (100.0) |

**Table-X**

*Distribution of vascular dementia patients according to gender (n-39)*

| Gender | Frequency | Percentage (%) |
|---|---|---|
| Male | 23 | 59 |
| Female | 16 | 41 |

Table X. shows distribution of VaD patients according to gender, where 23(59%) cases were male, 16(41%) cases were female. Male: Female ratio was 1.4:1

**Table XI**

*Distribution of fasting lipid profile of stroke patients (n=73) with VaD (n-39) and without VaD (n=34)*

| S. Lipid profile | Vascular dementia (VaD) | | Total (n-73)Mean |
|---|---|---|---|
|  | Yes (n-39) | No(n-34) |  |
| S. Total cholesterol (mg/dL) | 185.38 ± 44.07 | 178.70 ± 48.10 | 182.27 ± 45.79 |
| S. Triglyceride (mg/dL) | 149.82 ± 57.05 | 151.35 ± 76.12 | 150.53 ± 66.14 |
| S.LDL-C (mg/dL) | 133.58 ± 44.53 | 116.48 ± 42.39 | 125.75 ± 44.10 |
| S.HDL-C (mg/dL) | 31.07 ± 11.16 | 33.61 ± 11.82 | 32.26 ± 11.46 |

**Table XII**

*Frequency and severity of vascular dementia (VaD) according to type of stroke.*

| Type of stroke | Vascular dementia (VaD)(n-39) | | | Total |
|---|---|---|---|---|
|  | Mild (20-23) | Moderate (10-19) | Severe (<10) |  |
| Ischaemic stroke | 12 (100.0%) | 15 (93.8%) | 11 (100.0%) | 38 (97.4%) |
| Haemorrhagic stroke | 0 (0.0%) | 1 (6.2%) | 0 (0.0%) | 1 (2.6%) |
| Total | 12 (100.0) | 16 (100.0) | 11 (100.0) | 39 (100.0) |

Table XI. Shows fasting lipid profile of stroke patients (n-73) with VaD (n-39) and without VaD (34). Vascular dementia patients had higher s. total cholesterol, & s. LDL-C and lower s. triglyceride & s. HDL-C in comparison to that of non-vascular dementia patients.

Table XII. shows frequency and severity of vascular dementia (VaD) according to type of stroke. Among 39 VaD cases 38(97.4) had h/o ischemic stroke, of them 12 (100%) had mild, 15 (93.8) had moderate and 11(100%) had severe dementia. Among hemorrhage stroke patients only 1(2.6%) had moderate dementia.
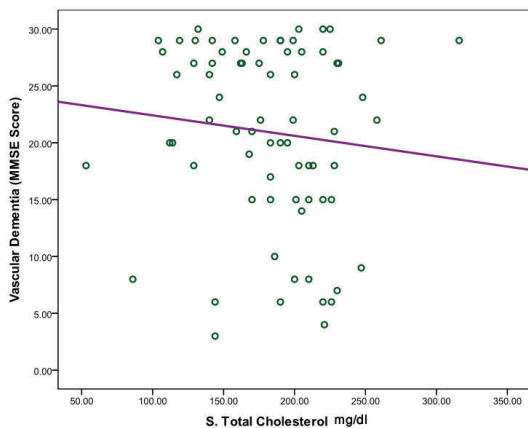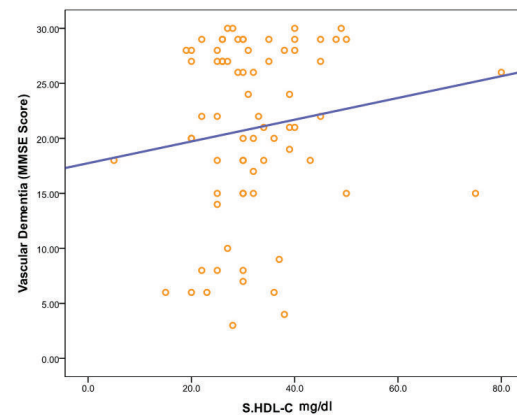


**Fig.-1:** *shows correlation of vascular dementia with S. Total cholesterol. (Pearson correlation, r=-0.104, p = 0.381). There was a non-significant negative correlation of MMSE score with S. total cholesterol.*
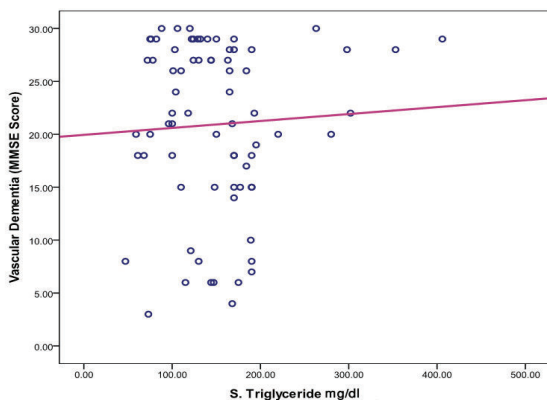


**Fig.-2:** *shows correlation of vascular dementia with S. Triglyceride. (Pearson correlation, r=0.055, p = 0.646). There was a non-significant positive correlation of MMSE score with S. Triglyceride.*
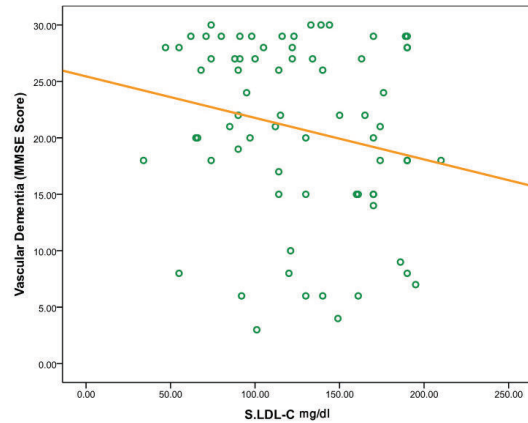


**Fig.-3:** *shows correlation of vascular dementia with S. LDL-C. (Pearson correlation r=-0.205, p = 0.084). There was a non-significant negative correlation of MMSE score with S. LDL-C.*



**Fig.-4:** *shows correlation of vascular dementia with S. HDL-C. (Pearson correlation, r=0.143, p = 0.227). There was a non-significant positive correlation of MMSE score with S. HDL-C.*

**Discussion:**

This cross-sectional descriptive study was carried out in the department of Neurology, Bangabandhu Sheikh Mujib Medical University, Dhaka to find out whether there is any association of hyperlipidemia with VaD among stroke patients. In this study it was observed that (Table-I) the mean age of stroke patients was 67.5±42.5 years and most of the patients 63(86.3%) were above 50 years old. Maximum 31(42.5%) patients were in the age group of 61-70 years, followed by 17 (23.3%) in age group of 51–60 years which is consistent with some other

studies done in home and abroad[25,26]. Among these stroke patients (Table-II) males 46(63.0%) were predominant than females 27(37.0%). Male female ratio was 1.7:1. Stroke is a male predominant disease shown in different studies in Bangladesh[25,27,28]. They found M:F ratio 2.75:1, 2.53:1 and 3.44:1 respectively. Again VaD (n-39) was also found common 18(46.2%) among stroke patients in the age group of 61-70 years, followed by 10 (25.6%) among 51-60 years age group (Table-X) and also found common 18(46.6%) among male VaD (Table XI) patients than female 16(41%), ratio M:F= 1.4:1 in this study. A Swedish study also found that incidence of dementia was more in male and in older patients[29]. The subjects with VaD were significantly older than individuals without dementia or than controls seen by Reitz et al 2004 in his study[30]. Educational status (Table-III) and occupation (Table-IV) of the patients were recorded. Only 7 (9.6%) patients were graduate and 9 (12.3%) were illiterate. Maximum (30.1%) patients completed their primary education followed by 21 (28.8%) and 14 (19.2%) completed their secondary and higher secondary education respectively. The subjects with VaD were significantly less educated than individuals without dementia or than controls [1,30-33]. Nagndu et at 2007 also found most of the dementia patients were either illiterate or read up to primary school level[34]. Sixteen (21.9%) patients were housewife, 13 (17.8%) were service holder, and 40 (54.8%) patients had miscellaneous occupation. In this study out of 73 patients (Table-VII), 40 (54.8%) were either smoker or ex-smoker and 33 (45.2%) were non-smoker. In another study done in this country showed 39.5% and 44% stroke patients were smoker [35] respectively. Among 73 cases 15(20.55%) patients had family history of stroke and 2(2.74%) patients had family history of dementia (Table-VIII) which is consistent with the study of Sarker; 2015, where 20% cases had positive family history of stroke and 2.5% had family of dementia, reflecting that stroke runs more in families than dementia[25]. Relevant past history of the patients was recorded (Table-VI). Sixty four (87.7%) patients had ischemic stroke and 9 (12.3%) patients had hemorrhagic stroke. Ischemic stroke patients were more likely to develop dementia [35,36]. Hyperlipidemia was present in 67 (91.8%) patients, HTN in 54 (74.0%), DM in 35 (47.9%) and IHD in 15 (20.5%) patients respectively. Sarker; 2015. found dyslipidaemia in 53.75% of his stroke patients and HTN in 60%, DM in 27.5%, IHD in 11.3% and recurrent stroke in 20% cases respectively[25]. So, this study is consistent with the study of Sarker, 2015[25]. Reitz et al; 2004 showed 62% had a history of Hypertension, 23.3% had a history of heart disease, and 19.9% had a history of DM[30]. Dimopoulos et al; 2007 found hypertension and DM in 50.0% dementia patients respectively[33]. It is well established that blood pressure can increase the risk of stroke. Many studies including Framingham, the Kungsholmen and the Honolulu-Asia aging studies have implicated impaired cognitive function to hypertension in geriatric patients [37,38]. In this present study 54(74%) patients were hypertensive which correlated with previous studies. Again, the previous two studies showed in their series of patients having HTN in 58.6% and 65% cases respectively [27,39].

DM or hyperglycemia have been associated with worse cognitive performance after stroke, but most assessments of these markers are confounded by the fact that these might both occur in response to stroke in the acute phase, or might be present in the setting of a large stroke. Additionally data on hyperglycemia were conflicting[40]. This study shows 35 (47.9%) patients had diabetes mellitus which is consistent with similar studies done in our country which showed diabetes as a risk factor for stroke in 32.1% and 21% cases respectively [27,39]. The association between VaD and diabetes was also described by other researchers [40,41]. Among 67 hyperlipidemia patients (Table-V) 37(55.2%) patients had stroke with VaD and 30(44.8%) patients had stroke without VaD in this study. In this study serum fasting lipid profile among VaD patients showed that total cholesterol, LDL-C, HDL-C and triglycerides were 185.38±44.07, 133.58±44.53, 31.07±11.06 and 149.82±57.05mg/dl respectively. In another two studies done by sarker; 2015, and Das; 2013, where these were 202.3±25.11, 117.28±18.88, 37.06±6.45, 208.88±15.41 (mg/dl) and 204.36±39.57, 117.07±42.44, 39.75±6.5,

237.67±6.1(mg/dl) respectively. So, the result of this current study coincides with the study of sarker, 2015 and Das, 2013[25,42]. In this study vascular dementia patients had higher s. total cholesterol (185.38 ± 44.07 vs 178.70 ± 48.10mg/dl), & s. LDL-C (133.58 ± 44.53 vs 116.48 ± 42.39mg/dl) and lower s. triglycerides (149.82 ± 57.05 vs 151.35 ± 76.12mg/dl) & s. HDL-C (31.07 ± 11.16 vs 33.61 ± 11.82mg/dl) in comparison to than that of non-vascular dementia patients. Reitz et al; 2004. found mean level of total cholesterol was 198.8 mg/dL, HDL-C 47.4 mg/dL, triglycerides 155.9 mg/dL and LDL-C 120.1 mg/dL among his patients[30]. Result of this study regarding HDL-C is consistent with the Reitz et al; 2004. study[30]. S. HDL-C level was significantly lower in VaD patients in comparison to normal subjects found by Dimopoulos et al; 2007[33]. Zuliani et al; 2001. found lower levels of HDL-C in subjects with VaD compared with controls[43]. Kuriyama et al; 1994. reported lower HDL-C levels in patients with VaD compared with controls[17]. Van Exel et al; 2002. found a significant association between decreased HDL-C levels and cognitive impairment[44]. Reitz et al; 2004. found an association between higher LDL-C levels and a higher risk of VaD[30]. Frequency and severity of vascular dementia (*VaD*) according to type of stroke was recorded (Table-XII) where 38(97.4%) patients had past history of ischemic stroke out of 39 VaD patients. Of them among 12 mild VaD patients all (100%) had ischaemic stroke, among 16 moderate VaD patients 15 (93.8%) patients had ischaemic stroke and rest 1 (6.3%) patient had hemorrhagic stroke, among 11 severe VaD patients all (100%)of them had ischemic stroke. Almost similar result was also seen by Sarker; 2015, in his study where 80% VaD patients had past history of ischemic stroke[25]. Desmond et at; 2000. also got similar result in his study [45].

In this study (Fig 1-4) there was a non-significant negative correlation of MMSE score with S. total cholesterol (Pearson correlation r=-0.104, p = 0.381), a non-significant negative correlation of MMSE score with S. LDL-C (Pearson Correlation r=0.205, P=0.84), a non-significant positive correlation of MMSE score with S. Triglyceride (Pearson correlation r=0.055, p = 0.646), and a non-significant positive correlation of MMSE score with S. HDL-C(Pearson correlation r=0.143, p = 0.227). S. HDL-C concentrations presented a positive linear correlation with the score on the MMSE rating scale seen by Dimopoulos et al, 2007 which is consistent with this study[33]. Lower S. HDL-C levels were associated with a slightly higher risk of VaD also seen by Reitz et al; 2004 in both either cross-sectional & prospective analysis[30]. They also found an association between higher S. LDL-C levels and a higher risk of VaD which is consistent with this study. Trkanjee et al; 2009 done a pilot study on stroke patients and evaluated the levels of cholesterol (Total, HDL-C and LDL-C) in patients with vascular dementia on 23 patients where 11 patients had cholesterol values within normal range and 12 patients had elevated levels of Total cholesterol – 5.78±1.06, and LDL-C-3.72±0.85 (mmool/L) and lower level of HDL-C-1.44±0.57mmol/L, however the difference was not statistically significant[46]. Again Zuliani et al; 2001 estimated S. lipoprotein profile in 60 older patients (age>60 years) in a cross-sectional study where he found, low HDL-C level only among VaD patients, values of other S. Lipoprotein were within normal range[43]. Moroney et al; 1999 conducted a prospective longitudinal community-based study over a 7 year period (1991-1998) on 1111 non-demented participants (mean age- 75±5.9 years) and were followed up for an average of 2.1 years (range 1-7.8 years)[47]. Of them 61 (21.3%) developed dementia following stroke. Levels of S. LDL-C were significantly associated with an increased risk of dementia with stroke but not other components of lipid in his study. In another study done by Solomon et al, 2009 in Department of Neurology, University of Kuopio, Kuopio, Finland; where they investigated Mild-life serum cholesterol in relation to Alzheimer's disease and vascular Dementia three decades later[48]. They selected 9,844 multiethnic participants of both sexes during 1964-1973 at ages 40-45 years. The researcher evaluated them for AD and VaD in 1994 and 2007 and found midlife serum total cholesterol was associated with an increased risk of both AD and VaD. Even moderately elevated cholesterol increased dementia risk. Another study done by

Cankurtaran et al; 2004. in Hacettepe University Division of Geriatric Medicine, Ankara, Turkey. They examined the relationship between dyslipidaemia and dementia on 1251 admitted patients[49]. The fasting Lipoprotein levels were measured in all patients and analyzed the data by using $X^2$ and one-way analysis of variance methods. But no relation was found with VaD patients in their study. In another done by Meilke et al, 2005 on association between plasma total cholesterol and triglyceride level and dementia among elderly patients aged>70 years[50]. They found high cholesterol in late life was associated with decreased dementia risk, which is not consistent with some previous studies suggesting high cholesterol in midlife is a risk factor for later dementia.

So, considering the results of studies done in home and abroad where some studies showed hyperlipidemia is associated with VaD [25,30,33,43,46-48] but association is weak which is consistent with our study. But some other studies shows no association [49,50].

**Conclusion**

This cross-sectional descriptive study done in a tertiary level hospital over a small sample (only 73 patients) demonstrates that VaD is common (53.4%) among stroke patients, where ischemic stroke occupies almost the whole bulk (97.4%). Hyperlipidemia is a modifiable risk factor for ischemic stroke and in this study it was also found that there is a non-significant positive association of VaD with high total cholesterol, high LDL-C, and low HDL-C and not with S. triglyceride. We can conclude that hyperlipidemia has weaker association with vascular dementia.

**References**

01. Leys D, Henon H, Mackowiak-cordoliani M A and Pasquier F. Post-stroke dementia. Lancet Neurol 2005;4:752-9.

02. Jorm A F, Korten A E, Henderson A S. The prevalence of dementia: A quantitative integration of the literature. Acta psychiatr scand 1987;76:465-79.

03. Youshitaka T, Kiyohora Y, Kato I. Incidence and risk factors of vascular dementia and Alzheimer's disease in a defined elderly Japanese population; The Hi-sayama study. Neurology 1995;45:1161-8.

04. Rencipe M, Ferretic C, Casani A R, Santini M, Giubelei F, Culasso F. Stroke, Disability and dementia: Result of population survey. Stroke 1997;28:531-6.

05. Zhu L, Fratiglioni L, Guo Z, Aguero-Torres H, Winbland B, Viitanen M. Association of stroke with dementia, cognitive impairment and functional disability in the very old: a population based study. Stroke 1998;29: 2094-9.

06. Tang W K, Chan S S, Chiu H F. Frequency and determinants of post-stroke dementia in chinese. Stroke 35:930-5.

07. Lin JH, Lin RT, Tai CT, Hsieh CL, Hsiao SF, Liu CK. Prediction of Post-stroke dementia. Neurolgy 2003;61:343-8.

08. Mok VC, Wong A, Lam WW. Cognitive impairment and functional outcome after stroke associated with small vessel disease. J Neurol Neurosurg Psychiatry 2004;75:560-6.

09. Zhou DH, Wang JY, Li J, Deng J, Gao C, Chen M. Study on frequency and predictors of dementia after ischaemic stroke: the Chongqing stroke study. J Neurol 2004;251:421-7.

10. Rasquin S M, Lodder J, Ponds R W, Winkens I, Jolles J, Verhey F R. Cognitive functioning after stroke: a one year follow-up study. Dement Geriatr Cogn Disord 2004;18: 138-44.

11. Kokmen E, Whisnant J P, O' Fallon WM, Chu C P, Bread C M. Dementia after ischeamic stroke: A population based study in Rochester, Minnesota (1960-1984). Neurology 1996;46:154-9.

12. Barba R, Martinez-Espinosa S, Rodriguez-Garcia E, Pondal M, Vivancos J, Del Ser T. Post-stroke dementia: clinical features and risk factors. Stroke 2000;31:1494-1501.

13. Henon H, Durieu I, Guerouaou D, Lebert F, Pasquier F, Leys D. Post-stroke dementia: incidence and relationship to pre-stroke cognitive decline. Neurology 2001;57: 1216-22.

14. Madureira S, Guerreiro M, Ferro JM. Dementia and cognitive impairment three months after stroke. Eur J Neurol 2001;8: 621-7.

15. Tzourio C, Anderson C, Chapmon N. Effects of blood pressure lowering with perindopril and indapamide therapy on dementia and cognitive decline in patients with cerebrovascular disease. Arch Intern Med 2003;163:1069-75.

16. Gorelick P B, Brody J, Cohen D. Risk factors for dementia associated with multiple cerebral infarcts: a case-control analysis in predominantly African-American hospital-based patients. Arch Neurol 1993;50: 714-20.

17. Kuriyama M, Takahashi K, Yamano T, Hokezu Y, Togo S, Osame M et al. Low levels of serum apolipoprotein $A_I$ and $A_{II}$ in senile dementia. Jpn j Psychiatry Neurol 1994;48:589-93.

18. Muckle TJ, and Roy J R. High-density lipoprotein cholesterol in differential diagnosis of senile dementia. Lancet 1985;1:1191-3.

19. Kuriyama M, Hokezu Y, Togo S, Nagata K, Takahashi K, Osame M. Serum Lipids, Lipoproteins and apolipoproteins in patients with senile dementia. Nippon Ronen Igakkai Zasshi 1992;29:559-64.

20. Klich-Raczka A, Necki M, Wizner B. Vascular dementia and systemic changes. Przegl Lek 2002;59:269-71.

21. Wieringa G E, Burlinson S, Rafferty J A, Gowland E, Burns A. Apolipprotein E genotypes and serum lipid levels in Alzheimer's disease and multi-infarct dementia. Int J Geriatr psychiatr 1997;12:359-62.

22. Scacchi R, De Bernardini L, Mantuano E, Bilardo T, Donini L M, Ruggeri M. DNA polymorphisms of apolipoprotein B and angiotensin-I coverting enzyme genes and relationships with lipid levels in Italian patients with vascular dementia or Alzheimer's disease. Dement geriatr cong Disord 1998;9:186-90.

23. Lesser G, Kandiah K, Libow L S, Likourezos A, Breuer B, Marin D et al. Elevated serum total and LDL cholesterol in very old patients with Alzheimer's disease. Dement Geriatr Cogn Disord 2001;12: 138-45.

24. Kuo Y M, Emmerling M R, Bisgaier C L, Essenburg A D, Lampert H C, Drumm D et al. Elevated low density lipoprotein in Alzheimer's disease correlates with brain $Aâ_1$-42 levels. Biochem Biophys Res Commun 1998;252:711-5.

25. Sarker I. Evaluation of Post-stroke dementia in different types of stroke patients (Thesis). Bangladesh College of physicians and surgeons, Dhaka; 2015.

26. Erkinjuntti T, Ostbye T, Steenhuis R, Hachinski V. The effect of different diagnostic criteria on the prevalence of dementia. N Engl J Med 1997;337:1667-74.

27. Khan M R K. Relationship between blood lipids, lipoproteins and ischemic stroke (MD-thesis). Bangabandhu Sheikh Mujib Medical University, Dhaka; 2000.

28. Hannan M A. Study of seasonal variation of stroke (Thesis). Bangabandhu Sheikh Mujib Medical University, Dhaka;1999.

29. Garcia J H, and Brown G G. Vascular Dementia: neuropathological and metabolic brain changes. J Neurol Sci 1992; 109: 121-31.

30. Reitz C, Tang M X, Luchsinger J, Mayeux R. Relation of plasma lipids to Alzheimer's disease and vascular dementia. Arch Neurol 2004;61(5): 705-14.

31. Tatemichi TK, Foulkes MA, Mehr J P. Dementia in stroke survivors in the stroke Data Bank cohort: prevalence, incidence, risk factors and computed tomographic findings. Stroke 1990;21:858-66.

32. Tatemichi TK, Desmond DW, Mayeux R, Paik M, Stern Y, Sano M et al. Dementia after stroke: Baseline frequency, risks, and clinical features in a hospitalized cohort. Neurology 1992;42:1185.

33. Dimopoulos N, Piperi C, Salonicioti A, Psarra V, Mitsonis C, Liappas L et al. Characterization of the Lipid Profile in Dementia and Depression in the Elderly. J Geriatr Psychiatry Neurol 2007;20: 138.

34. Ngandu T, Von Strauss E, Helkala E L. Education and dementia what lies behind the association? Neurology 2007;69:1442-50.

35. Bhuiyan M M, Islam M N, Khan R K, Rahman M M, Hayee M A, Jahan M. Etiological Pattern of demented patients attending in a tertiary hospital. Mymensingh Medical College Journal 2000;22(3): 496-503.

36. Tatemichi T K, Paik M, Bagiella E, Desmond D W, Stern Y, Sano M et al. Risk of dementia after stroke in a hospitalized cohort: results of a longitudinal study. *Neurology* 1994;44:1885–91.

37. Pendledury S T, Rothwell P M. Prevalance, incidence and factors associated with pre-stroke and post-stroke dementia: a systematic review and meta-analysis. Lancet Neurol 2009;8(11):1006-18.

38. Guo Z, Viitanen M, Fratiglioni L, and Winblad B. Low blood pressure and dementia in elderly people: the Kungsholmen project. British Medical journal 1996;312:805-8.

39. Ullah AKMA, Habib M, Mohammad Q D, Ahmed S, Nahar S. Review of risk factors of stroke: study of 100 cases. Bangladesh Journal of Neurosciences 1993;9: 11-20.

40. Elias M F, Wolf P A, D' Agostion R B, Cobb J, and white L R. "Untreated blood pressure level is inversely related to cognitive functioning: the Framinghan study". American Journal of Epidemiology 1993;138(6): 353-64.

41. Censori B, Manara O, Agostenis C, Camerlingo M, Castro L, Galavotti B et al. Dementia after first stroke. Stroke 1996; 27:1205-10.

42. Das B K. Association of serum triglyceride with ischaemic stroke (Thesis). Bangabandhu Sheikh Mujib Medical University, Dhaka;2013.

43. Zuliani G, Bel A, Zanca R, Munari M R, Zurlo A, Vavalle C et al. Lipoprotein profile in older patients with vascular dementia and Alzhemer's disease. BMC Geriatrics 2001;1:1-5.

44. Van Exel E, de Craen A J, Gussekloo J. Association between high-density lipoprotein and cognitive impairment in the oldest old. Ann Neurol 2002;51:716–21.

45. Desmond DW, Moroney JT, Paik MC, Sano M, Mohr JP, Aboumatar S et al. Frequency and clinical determination of dementia after ischemic stroke. Neurology 2000, 54:1124-31

46. Trkanjec Z, Béné R, Martinic-Popovic I, Jurasic JM, Lisak M, Seric V et al. Serum HDL, LDL and total cholesterol in patients with Late-life onset of Alzheimer's disease versus vascular dementia. Acta clin croat 2009;48:259-63.

47. Moroney J T, Tang M X, Berglund L, Small S, Merchant C, Bell K et al. Low-density lipoprotein cholesterol and the risk of dementia with stroke. JAMA 1999;282:254-60.

48. Solomon A, Kivipelto M, Wolozin B, Zhou J, Whitmer R A. Midlife serum cholesterol and increased risk of Alheizmer's and vascular dementia three decades later. Dement Geriatr Cong Disord 2009;28:75-80.

49. Cankurtaran M, Yavuz B B, Halil M, Dagli N, Cankurtaran E S, Ariogul S. Are serum lipid and lipoprotein levels related to dementia? Archives of Gerontology and Geriatrics 2004;41:31-39.

50. Mielke M M, Zandi P P, Sjogren M, Gustafson D, Ostling S, Steen B et al. High total cholesterol levels in late life associated with reduced risk of dementia. Neurology 2005;64:1689-95.