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A prospective study on the role of modifiable risk factors in young ischemic stroke patients

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Abstract
Aims and objectives
1. To analyze the prevalence of modifiable risk factors in young ischemic stroke patients.
2. To analyze the degree of significance of the modifiable risk factors in young ischemic stroke patients.
3. To analyze the age and gender distribution of the individual modifiable risk factors.
4. To compare between the modifiable risk factors in order to assess possible correlation between them.

Materials and methods
Study design: This study was undertaken as a case-control study among patients admitted to Dr SM CSI Medical College Hospital, Karakonam in the department of neuro-medicine.
Study population: Case: A case was defined as a person aged 45 yrs. or less who had sustained an ischemic stroke i.e. abrupt onset of a neurological deficit that was attributable to a focal vascular cause, caused by arterial occlusion and confirmed by CT scan of the head.
Sample size: The odds ratio of the smallest risk factor was considered and the sample size was calculated accordingly. The number of cases and controls studied were 60 each.
Results and conclusion: The study was undertaken as a case control study among patients admitted to Dr SM CSI Medical College & Hospital, Karakonam, 60 cases with young ischemic stroke and 60 matched controls were included in the study. Data regarding study variables was collected using a structured interview schedule; Data was analyzed using appropriate statistical measures. The following conclusions were arrived at.

Keywords: Stroke; young; modifiable; young; neurology

Introduction
A stroke or cerebrovascular accident refers to the abrupt onset of a focal neurological deficit that is attributable to a focal vascular cause. The World Health Organization (WHO) defines stroke as "rapidly developing clinical signs of focal (or global) disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than of vascular origin.

The pathological background for stroke may either be ischemic or hemorrhagic disturbances of the cerebral blood circulation. Cerebral ischemia is caused by a reduction in blood flow that lasts longer than several seconds. Neurological symptoms are manifest within seconds because neurons lack glycogen, so energy failure is rapid. If cessation of blood flow lasts for more than a few minutes, infarction or death of brain tissue results. When blood flow is restored quickly, brain tissue can recover fully and the patient's symptoms are only transient. This is called a transient ischemic attack - TIA. The standard definition of TIA requires that all neurological signs and symptoms resolve within 24 hours regardless of whether there is imaging evidence of new permanent brain injury. Stroke has occurred if the neurological signs and symptoms last for more than 24 hours. However, a newly proposed definition classifies those with new brain infarction as ischemic strokes regardless of whether symptoms persist'.

The 1990 Global Burden of Disease (GBD) study provided the first global estimate on the burden of 135 diseases, and cerebrovascular diseases ranked as the second leading cause of death after ischemic heart disease. Data on causes of death from the 1990s have shown that Cerebrovascular diseases remain a leading cause of death. In 2001 it was estimated that

stroke accounted for 5.5 million deaths worldwide, equivalent to 9.6% of all deaths. Two-thirds of these deaths occurred in people living in developing countries and 40% of the subjects were aged less than 70 years. Additionally, cerebrovascular disease is the leading cause of disability in adults and each year millions of stroke survivors have to adapt to a life with restrictions in activities of daily living as a consequence of stroke. Many surviving stroke patients often have to depend on other people's continuous support to survive.

Though stroke is uncommon in children who are aged younger than 15 years (the annual incidence being approximately 2.5 cases per 1,00,000 children), ischemic stroke in young adults (15-45 years) is not uncommon and accounts for up to 12% of all first ischemic strokes and up to 2 million young people each year worldwide. Cerebral infarction may have serious consequences for patients in their prime of life and influence on choice of education, vocation, and family planning. In terms of prognosis a young stroke has a dramatic influence on independence and quality of life as it occurs in the period of life that people start to form families, make decisive career moves, and have an active Social life. Uncertainty about long term prognosis affects choices and planning affiliated with these life events. Although the absolute number of young stroke is lower than stroke among the elderly, the total number of years that young stroke patients as a whole will live with the consequences of the stroke exceeds that of older stroke Survivors due to far longer survival.

Although the frequency of ischemic stroke in young adults is far less than that in Individuals who are older than 50 years, the causes are more diverse. Important causes include premature atherosclerosis, cardiogenic embolism, hematological diseases, large vessel occlusive diseases and Small vessel disorders. In most series, the most common causes of ischemic stroke in young adults are premature atherosclerosis, cardiogenic embolism and use of oral contraceptives. The available data indicate that stroke occurring in young people is more often atherothrombotic in origin in developing countries, in contrast with developed countries where arterial dissection and cardioembolic etiologies predominate. It is possible that ischaemic stroke occurring in young Indians may be a manifestation of accelerated cerebrovascular atherosclerosis, paralleling the early age of onset of cardiovascular diseases noted for this population. Additionally, based on prior data on increased propensity for insulin resistance among South Asians, it is also likely that ischaemic stroke in young adults in India may be associated with the combination of risk factors that identify the metabolic syndrome. Assessing these and a few other possibly related modifiable risk factors provides a potential window of opportunity to intervene in susceptible population groups.

The Important modifiable risk factors for ischemic stroke are systemic hypertension, diabetes mellitus, dyslipidemia, atrial fibrillation, cigarette smoking, heavy alcohol consumption, lack of physical activity, obesity and unhealthy diet. Case control studies evaluating risk factors for ischaemic stroke in young adults in India are quite rare. The present study aims to identify the modifiable risk factors of young ischemic stroke among those patients admitted to the medicine and neuromedicine wards in Dr SM CSI Medical College by comparing them to matched controls.

Data on dyslipidemia, obesity, sedentary life style and physical inactivity, cigarette smoking, systemic hypertension, diabetes mellitus, alcohol abuse, cardiac diseases, urban dwelling, intake of oral contraceptive pills and previous history of stroke or TIA was collected using a structured interview schedule and was assessed using standard statistical techniques.

As medicine moves into the 21st century, with the added pressure of increasing costs and limited resources, and more so for a protracted case of young ischemic stroke, successful reduction of the impact of stroke on the population will require shifting emphasis from treatment of end stages of generalized atherosclerosis to primary prevention of underlying diseases and stroke. This approach will require more sophisticated and more definitive studies to identify, verify and better explain the relative importance of known risk factors, the interaction of various risk factors, and the existence of currently unknown or unverified risk factors.

With successful primary prevention of stroke now becoming possible with the identification of important risk factors in elderly stroke patients, it is high time that the same advantage is translated into the younger sections of the society. Stroke is now identified to be preventable in at least 80% of the cases. It can be prevented by identifying individuals at high risk and initiating a cost-effective approach to address the reversible risk factors. An even greater impact can be realized by instituting broader healthy lifestyle components across the population, beginning in young age groups and focused on preventing stroke risk factors before they develop.

Materials and methods

Study design: This study was undertaken as a case-control study among patients admitted to Dr SM CSI Medical College Hospital, Karakonam.

Study setting: Cases obtained from Medicine and neuromedicine wards in Dr SM CSI Medical College and Hospital, Karakonam, is a tertiary care referral center which caters to a large population covering approximately three districts. Though having a majority of tropical disease cases, bed occupancy by stroke patients are significant, in the order of around 15%. Controls were selected from among the bystanders of patients admitted to medicine wards.

Study population: Case: A case was defined as a person aged 45 yrs. or less who had sustained an ischemic stroke i.e. abrupt onset of a neurological deficit that was attributable to a focal vascular cause, caused by arterial occlusion and confirmed by CT scan of the head.

Exclusion criteria

Comatose or seriously ill patients
Patients with mental diseases
Non cooperative Patients
Patients with myocardial infarction because of common pathophysiology Controls: A control was defined as a person aged 45 years or less and not having a stroke or myocardial infarction.

Sample size

Sample size was calculated based on a similar study conducted in Taiwan titled 'Etiological study of young ischemic stroke in Taiwan'. The odds ratio of the smallest

risk factor was considered and the sample size was calculated accordingly. The number of cases and controls studied were 60 each.

Study variables: the following were the definition of study variables to be considered

1. Hyperlipidemia: Fasting lipid profile shows Total Cholesterol 2 200 mg/dl with or without raised LDL cholesterol (2 100 mg/ dl) and/or HDL cholesterol < 50 mg/dl and/or Triglycerides >150 mg/dl.
2. Obesity: BMI > 30 and/or waist circumference 2 90 cm in men and 2 80 cm in women. Waist circumference is measured horizontally, midway between the iliac crest and costal margin, irrespective of the position of the umbilicus.
3. Sedentary life style and physical inactivity: based on the profession, and physical exercise. For statistical analysis profession was classified into mild, moderate and heavy labour as follows,

Heavy labour included- manual labour, coir worker, cashew nut factory worker, carpentry, mason, fisherman, fisherwoman, farmer, painter, army man, welder, baker and workshop worker.

Moderate labor included shopkeeper, driver, tailor, housewife, photographer, electrician, cobbler, rubber tapper, hotel worker. Mild labour included businessman, teacher, professional e.g. accountant, manager, student

4. Cigarette smoking: Smoking 2 10 cigarettes per day for 2 6 months before the stroke
5. Systemic Hypertension: (a) Previously diagnosed as hypertension by a physician or (b) Systolic BP 2140 mm Hg and/or diastolic BP 2 90 mm Hg on 2 different occasions at least 2 weeks after the onset of the stroke. Mean arterial Pressure was calculated as diastolic blood pressure + 1/3rd of pulse pressure.
6. Diabetes Mellitus: (a) Symptoms of diabetes mellitus (polyuria, polydipsia, unexplained weight loss) + random blood sugar (RBS) 2 200mg/dl or (b) FBS 2 126 mg/dl or (c) 2 hr PPBS 2 200mg/dl or HBA1C 2 6.5%
7. Alcohol abuse: Intake of alcohol 2 30 gm per day and/or 2 210 gm per week for more than 6 months before the stroke. (10 gm= 30 ml 1 unit of brandy, whisky etc.)
8. Cardiac diseases: Documented history of heart disease or newly detected heart diseases like valvular heart disease, atrial fibrillation or ischemic heart disease by ECHO or ECG.
9. Intake of Oral Contraceptive Pills: considered present when the subject reported using these medications at any time in her life
10. Previous history of TIA or stroke: considered present when the subject had at least one episode of stroke or TIA in the past. TIA is defined as focal neurological deficit of acute onset and lasting for less than 24 hours.

Data collection

Data was collected by means of a structured interview schedule. Patients getting admitted in Medicine and Neuromedicine wards as per the case definition was tracked and details collected. Details included personal details, relevant historical details, clinical findings including vital signs and laboratory values.

Data analysis

Data was analyzed using Statistical Package for Social Sciences (SPSS) version 10. Frequencies of different exposures among both cases and controls were estimated. The differences in observation were tested statistically using chi-square test. The strength of association was measured using Odds ratio and its confidence interval. Multi-variate analysis using Binary logistic regression was carried out and adjusted Odd's ratio estimated. For all statistical evaluations a two- tailed probability of value, <0.05 was considered significant.

Results and analysis

1. Age distribution of study subjects

Table 1:

Factor	Case (n=60)	Control(n=60)
Age <37 years	24(40%)	39(65%)
Age >37 years	36(60%)	21(35%)

X2-7.52;df-1;p value-0.006

Out of the 120 subjects studied (cases and controls), the median age was found to be 37 years. Out of the 60 cases, 24 (40%) were found to be less than or equal to 37 years whereas the majority (60%) were aged more than 37 years. Out of the 60 controls, 39 (65%) subjects were aged less than or equal to 37 years. This was statistically significant. Of the 24 cases aged less than or equal to 37 years, 20 were males and 4 were females. The mean age among the 60 subjects was 38 years and the mean age among the 60 controls was 34 years. The youngest study subject among cases was aged 25 years and the oldest was aged 45 years. There were no cases in the 15- 25 years age group.

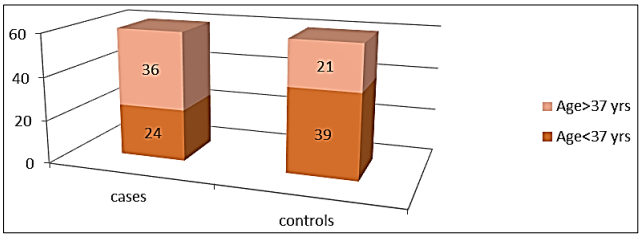

Fig 1: Age distribution of study subjects

2. Gender distribution of study subjects

Table 2:

Factor	Cases(n=60)	Controls(n=60)
Male	43(71.66%)	48(80%)
female	17(28.33%)	12(20%)

X2-1.14;df-1;p value-0.286

Out of the 60 cases, 43 (71.66%) were males and 17 (28.33%) were females, which was comparable to the control group as well where 48 (80%) ware males and 12 (20%) were females (Table 2), The number of males was more than twice the number of females, thereby showing a definite male preponderance among young ischemic strokes in the present study. Of the 43 males in the cohort of cases, 20 were aged less than or equal to 37 years (46.5%) and 23 males were aged more than 37 years. Among females, however, out of the 17 cases only 4 (23.5%) were aged less than or equal to 37 years.

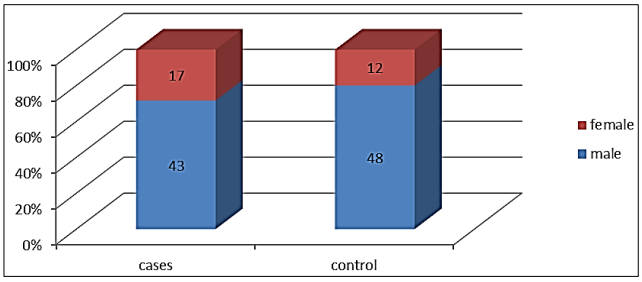

Fig 2: Gender distribution of study subjects

3. Occupation of study subjects

Table 3:

Factor	Cases(n=60)	Controls(n=60)
Heavy labour	27 (45%)	26 (43..33%)
Moderate labour	29 (48.33%)	24(40%)
Mild labour	4(6.66%)	10(16.6%)

X2-3.06;df-2;p value -0.216

Of the 60 cases, 29 (48.3%) were involved in moderate labour, 27 (45%) in heavy labour and only 4 (6.6%) in mild labour. It was more or less comparable in the control group where 26 (43.3%) were involved in heavy labour, 24 (40%) in moderate labour and 10 (16.6%) in mild labour (Table 3).
Of the 27 cases involved in heavy labour, 23 were males (85.2%) whereas only four were females. More males than females were involved in heavy labour. 16 of the 27 cases were aged more than 37 years and 11 were aged s 37 years. Among those involved in moderate labour, however, there was a more uniform distribution among cases with 17 of the 29 cases being males and the remaining 12 being females. 16 of these 29 cases were aged more than 37 years and 13 were aged <37 years, Of the 4 people involved in mild labour, 3 were males and one was a female.
Heavy labour included- manual labour, coir worker, cashew nut factory worker, carpentry, mason, fisherman, fisherwoman, farmer, painter, army man, welder, baker and workshop worker. Of these manual labour was the most Common profession among both the cases and controls. Moderate labour Included shopkeeper, driver, tailor, housewife, photographer, electrician, cobbler, rubber tapper, hotel worker Mild labour included businessman, teacher, professional e.g. accountant, manager, student
It was evident that the majority of those affected were involved in moderate to heavy labour category

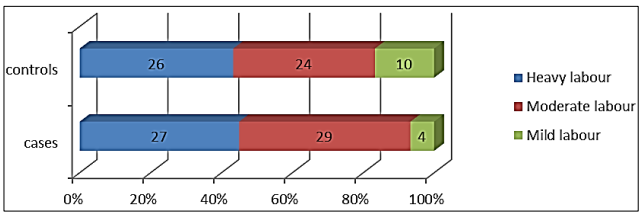

Fig 3: Occupation of study subjects

4. Place of residence

Table 4:

Factor	Cases(n=60)	Controls(n=60)
Living outside city	48(80%)	45(75%)
Living within city	12(12%)	15(25%)

x2-0.430; df - 1; p value - 0.512

48 out of the 60 cases (80%) were staying outside city limits while 12 (20%) were staying inside city limits. 45 out of the 60 controls (75%) lived outside the city while 15 (25%) lived within the city (Table 4). Of the 12 cases that lived within city limits, 4 were females and 8 were males. There was no obvious difference between the case and the control group regarding the place of stay with regard to the occurrence of stroke.

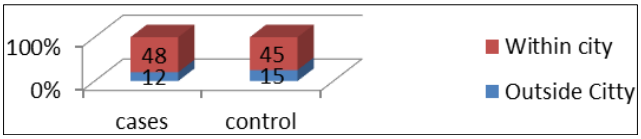

Fig 4: Place of residence

5. Past history of stroke or TIA

Table 5:

Factor	Case(n=60)	Controls(n=60)
Past history present	3(5%)	1(1.66%)
No past history	57(95%)	59(98.33%)

x2 - 1034, df - 1; p value - 0.309

Only 3 out of the 60 cases (5%) had a positive past history of stroke or TIA whereas one case out of the 60 controls had a positive past history (Table 5). All the 3 cases who had a positive past history of stroke or TIA were males, one was aged 45 years, another 35 years and the third 31 years.

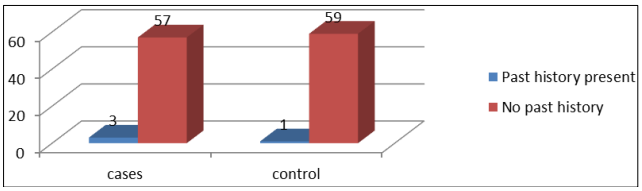

Fig 5: Past history of stroke or TIA

6. History of smoking

Table 6:

Factor	Case(n=60)	Control(n=60)
Smokers	27(45%)	14(23.33%)
Non smokers	33(55%)	46(76.66%)

x2- 6 261, df-1; p value - 0.012

27 out of the 60 cases (45%) were smokers. This was statistically significant (p value 0.012) considering that only 14 out of 60 controls (23.3%) were smokers (Table 6). Of the 27 cases, 14 were aged more than 37 years compared to 13 cases aged s37 years. Of the 13 cases aged <37 years, only 3 were aged 30 years or less. Of the 27 smokers among the cases, 17 subjects had a pack year value s5 and 10 had pack years > 5, none of the smokers among cases or controls were females

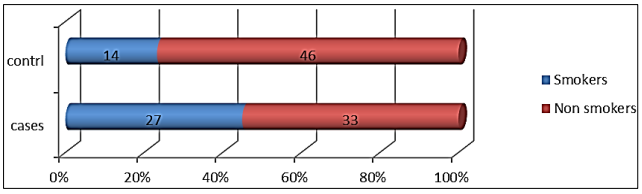

Fig 6: History of smoking

7. History of alcoholism

Table 7:

Factor	Case(n=60)	controls(n=60)
Alcoholism	16(26.66%)	9(15%)
Non-alcoholic	44(73.33%)	41(85%)

x2 -2.476; df - 1; p value - 0.116

Out of the 60 cases, 16 (26 6%) were alcoholics as per the criteria, whereas only 9 out of the 60 controls (15%) were alcoholics (Table No. 7) Even though the difference was not statistically significant, a substantial number of the cases (nearly one fourth) turned out to be alcoholics as per the criteria Of the 16 alcoholics among the study subjects, 6 patients took 500 or more ml per week. All of these 6 subjects consumed alcohol for al least 4 years, and the average duration of alcohol consumption was 11.7 years. Among the remaining 10 subjects who consumed less than 500 ml of alcohol per week, the average duration of consumption was 9.1 years. Among controls only one person consumed more than 500 ml alcohol per week for a total duration of 5 years. The remaining 8 alcoholics in the control group consumed alcohol for an average of 7.4 years.
Among the 16 study subjects who consumed significant amounts of alcohol in the cohort of cases, 10 subjects were aged 37 years or less, compared to 3 out of the 9 study subjects in the cohort of controls. None of the alcoholics in the cohort of cases or controls were females.

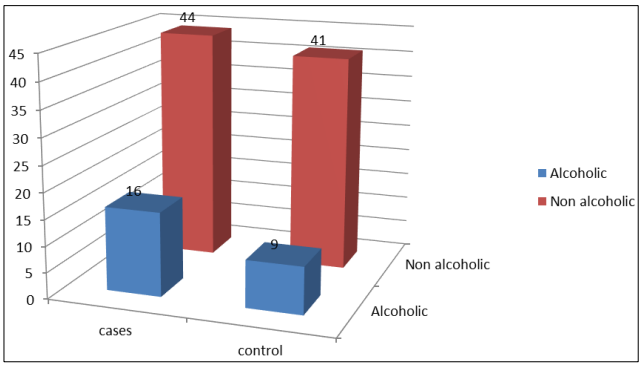

Fig 7: History of Alcoholism

Discussion

Sixty cases aged less than 45 years who had suffered an ischemic stroke and fulfilling the criteria for young stroke were included in the study. Sixty controls in the same age group who had not suffered a stroke were included for comparison.
The age of the cases ranged from 25 years to 45 years with a mean age of 38 years. The youngest person in the study was 25 years old and the oldest was 45 years. 10% were in the 25-29 age group, 48.3% were in the 30-39 years age group and the remaining 41.7% were in the 40-45 years age group. The median age was 37 years and 60% of the cases were aged more than 37 years.
According to a young ischemic stroke study conducted by Bo Kristensen *et al*. " in Northern Sweden the majority of the cases enrolled were more than 37 years (67%) which is comparable to the present study where 60% cases were aged more than 37 years. Another study conducted in Sree Chitra Thirunal Institute of Medical Sciences; Trivandrum found that 70% of the cases under study were in the 20-40-year age group. The latter study also underscored the importance of targeting adolescents and young adults for screening and prevention to reduce the burden of ischemic stroke in young adults.
In the present study 43 cases (71.66%) were males and 17 (28.33%) were females with a male to female ratio of 2.5. This was comparable to similar studies conducted in Asian countries including Taiwan (71.4%) and Korea (75.2%) Western countries however did not show that high a disparity among males and females (44.1% - 58.9%). The high percentage of males suffering young ischemic stroke in India probably reflects the increased incidence of the various perceived conventional risk factors in males as compared to females, important among which would be smoking and alcoholism. It is also reflective of the high incidence of the key components of the metabolic syndrome in males as compared to females.
56 out of the 60 study subjects (93.3%) were involved in moderate to heavy labour as compared to 50 out of the 60 controls. This was not statistically significant and it would therefore be inappropriate to consider that mild forms of labour are protective against young stroke. Since Dr SM CSI Medical College primarily caters to a population which is low in the socioeconomic strata and which earns its livelihood through moderate to heavy labour, the above-mentioned statistics could at best be considered representative of the patient population that attends the medicine and neuromedicine outpatient departments.
However, this could also be considered as a possible pointer towards the higher incidence of young strokes among the lower socioeconomic status group. Knowledge about health-related issues and advances in medical care may not be prevalent in lower socioeconomic groups and access to information may be limited. Work- related stresses among men with jobs that have high demands and low rewards and its association with alcohol, tobacco or drug abuse may be contributory factors to the high incidence of 201 young strokes among the lower socioeconomic groups.
80% of the cases were found to be living outside the city limits as Compared to 75% of the controls. This, again, would be more a representation of the socioeconomic status of the patient population to which Dr SM CSI Medical College caters and it would probably be premature to brand city living as protective against young ischemic stroke. It is further supportive of the aforementioned possibility that lower socioeconomic status poses as a potential risk factor for young ischemic stroke.
Only 3 out of the 60 cases (5%) in the present study had a positive past history of stroke or TIA. Though comparative statistics were few, one such study conducted in Sree Chitra Thirunal Institute in Trivandrum had a much higher percentage (13%) of positive past history. The latter study was conducted between 1988 and 1994 in the same area where the present study was conducted and hence the improvement in the current statistics could be attributed to the advancements in the literacy and awareness levels coupled with the adoption of more effective therapeutic and preventive strategies by the general population. It is also a significant pointer towards the benefits that can be reaped if primary prevention strategies are employed in a susceptible yet receptive and productive population.
The present study showed 45% i.e. 27 out of the 60 cases to be smokers. This was statistically significant considering that only 14 out of 60 controls (23.3%) were smokers (p value 0.012). None of the females in either the case or the

control group were smokers. The high percentage of smokers among the cases of young stroke was similar to other such Asian studies. Studies conducted in Taiwan and Korea had a similar incidence of smoking among young strokes (49.8%) Another study of young stroke conducted in Sree Chitra Thirunal Institute, Trivandrum", showed that 37% of the cases Mere smokers. Though this was comparable to the result obtained in the present study, the mild disparity in the percentage could be due to the difference in the inclusion criteria, with the former study allowing only current smokers to fulfill the criteria, However, a similar study conducted in the same institute' more than 10 years back, came up with a 47% incidence of smoking among the cases, even while employing a longer duration of smoking (at least two years) to fulfil the criteria.

Out of the 27 smokers, only 3 (11.1%) were aged 30 years or less and the remaining 24 cases (88.9%) were in the 31-45-year age group. This was different from the above-mentioned study' where the corresponding percentages were 15.6% and 84.4%. This change observed over a period of 10 years is suggestive of lesser numbers among the younger population resorting to smoking and is an encouraging pointer towards the various socio-political measures adopted to demystify smoking while at the same time propagating the harmful effects of smoking. The percentage of smokers among young strokes, however, has not changed significantly and is a grim reminder of extent to which this social evil has penetrated into civilized society.

In the present study 16 out of the 60 cases (26.66%) were alcoholics as per the criteria compared to only 9 out of the 60 controls (15%). Even though the difference was not statistically significant, a substantial number of the cases (nearly one fourth) turned out to be alcoholics. A similar study conducted in Sree Chithra Institute, Trivandrum, showed that 22% of the cases were moderate to severe alcoholics while yet another study conducted in Taiwan" put the percentage as 27.3% which was closer towards the value obtained in the present study. The higher incidence of young strokes among alcoholics could be linked to the increased incidence of smoking and hypertension seen commonly in this subgroup.

In the present study 16 out of 60 cases (10%) had a positive history of ischemic heart disease. This was comparable to the 11.1% incidence of ischemic heart disease in stroke in the Framingham Heart Study In the Framingham Study, when multivariate analysis was used, risk of stroke was increased twofold coronary threefold by electrocardiographic left ventricular hypertrophy, and threefold to fourfold by cardiac failure, In a separate analysis Framingham, left ventricular mass assessed by echocardiography was also predictive of stroke in follow-up.

11 out of 60 cases (18.3%) had a positive history of valvular heart disease compared to none among the control group. According to a study conducted in Taiwan", 24.1% of the cases had valvular heart disease detected by echocardiography whereas the study conducted in Sree Chitra Institute showed an 11.3% incidence of valvular heart disease among young strokes. The higher incidence in the more recent present study compared to the older Sree Chithra study would be probably reflective of the higher pick up rate of valvular lesions in view of more prevalent use of echocardiography.

In the present study 7 out of 60 cases had a positive history of atrial fibrillation compared to none among the control group. In the above-mentioned study conducted in Taiwan there were 5 cases of atrial fibrillation among the study population. In the Framingham Study, nonvalvular AF was independently associated with a threefold to fivefold increased risk for stroke.

In our study 21.6% (13out of 60 cases) were found to have total cholesterol 2 200 mg/dl compared to 4 out of 60 (6.6%) controls and this was cholesterol significant (p value 0.018). Out of the 13 cases of high total cholesterol, 0 were men and 4 were women. 11 patients had total cholesterol in the range of 201-250 mg/dl and one each had their total cholesterol in the ranges 251- 300mg/dl and 300 mg/dl respectively. A similar study conducted in Northern Sweden had an18.7% incidence hypercholesterolemia among the study subjects whereas the corresponding value in the study conducted in Taiwan" was 53, 1%.

The study conducted in Sree Chithra among young ischemic stroke patients from 1988 -1994', came up with a 17% incidence of hypercholesterolemia among its study subjects. The lower percentage obtained in this study compared to the present study could be attributed to the higher cut-off for hypercholesterolemia (>240 mg/dl) employed in the former. According to the above-mentioned study, the role dyslipoproteinaemia in the pathogenesis of cerebrovascular disease in less certain than for coronary artery disease; more consistent association has been noted with low HDL cholesterol and high total cholesterol to HDL cholesterol ratio than with total cholesterol, low density lipoprotein cholesterol and triglycerides.

According to a study conducted by the Medical Research Council/British Heart Foundation, administration of simvastatin to those with prior occlusive vascular disease reduced the incidence of stroke significantly (p<0.0001)10, Hyperlipidemia was also clearly associated with progression of carotid and peripheral atherosclerosis and intima-media thickness, a marker of early atherosclerosis 10 The findings in the present study could possibly be explained by these above mentioned facts.

11 out of 60 cases (18.3%) (9 males and 2 females) had triglyceride level 2 150 mg/dl compared to 7 out of 60 (11.6%) (all males) controls. According to a study conducted in Northern Sweden ", 10,28% of cases had high triglyceride level. Triglyceride levels and non-HDL cholesterol were not associated with stroke risk as per the study conducted in Sree Chitra Institute and this is in agreement with the present study where too the correlation was not found to be statistically significant.

Of the 60 cases, 45 (75%) had low HDL cholesterol (37 males and 8 females) compared to 31 (29 males and 2 females) out of 60 controls (51.6%) and this was statistically significant (p value 0.008). According to study conducted in Sree Chitra Institute, HDL cholesterol was related Inversely to stroke (83% lower odds per SD increment). In multivariable models incorporating the ratio of total to HDL cholesterol, a unit increase in le ratio was associated with a doubling of stroke risk (p<0.0001). These relations were consistent when analyses were repeated excluding individuals with cardio embolic stroke and stroke due to other etiologies.

Low HDL cholesterol was the only serum lipid index associated with an increased risk of ischaemic stroke among 94 consecutive patients under 45 years admitted to a tertiary care facility in Toulouse, France, when compared with 111 controls of the same age. In a case control study involving

204 patients with acute ischaemic stroke of all ages from Chennai, South India, the authors found that while low HDL cholesterol and high total cholesterol to HDL cholesterol ratio were more frequent among patients, total serum cholesterol, triglycerides and low-density lipoprotein cholesterol levels did not significantly differ. HDL cholesterol plays a fundamental role in the regulation of atherogenesis via its effects on reverse cholesterol transport and vascular remodeling. The results obtained in the present study are consistent with the above-mentioned observations. The current study also observed that dyslipidemia was more prevalent in males than in females.

The present study had 12 out of the 60 cases (20%) having a fasting blood sugar value > 126 mg% compared to 7 out of 60 controls (11.6%). 11 out of 60 cases (18.3%) had a post prandial blood glucose value > 200 mg/dl compared to 3 out of 60 controls (5%) and this was statistically significant. In a recent study conducted at Sree Chitra Institute, a strong association between hyperglycemia and risk of young stroke was obtained when cases were compared with community controls. However, the same was not seen when cases were controlled with hospital controls. One potential explanation proposed was that hospital controls had higher blood sugar levels relative to community controls, possibly due to the stress of the hospital environment. Other investigators have reported that hospital controls may resemble cases more, and hence differ from community controls.

Another study conducted in Sree Chithra Institute more thana decade ago came up with a 7% incidence of diabetes among young ischemic strokes. In a prospective study of young stroke patients conducted in diabetes was detected in 5% of the patients. Similar studies Gambia conducted in the US" and Sweden" had much lower percentages of diabetes of 2,8% and 1.8% respectively among their cases of young stroke, compared to the above-mentioned studies, our study had a much higher prevalence of hyperglycemia among the study subjects. Read in conjunction with the more recent study conducted in Sree Chithra Institute", the findings of high blood glucose among young ischemic stroke patients is an ominous pointer towards the rising incidence of metabolic syndrome in the young population of Kerala.

Waist circumference, levels of physical activity/physical exercise, Hemoglobin levels and ESR measurements were not significantly different in the group of 60 cases compared to the 60 controls.

In the present study, 19 out of 60 cases (31.6%) had systolic blood pressure 2 140 mm Hg compared to only 5 out of 60 controls (8.3%) which was statistically significant (p value 0.001). 18 out of 60 cases (30%) had a diastolic BP 2 90 mm Hg compared to 5 out of 60 controls (8.3%) and this too was statistically significant (p value 0.003). In the similar study conducted in Sree Chitra Institute', hypertension was found in 18% of the patients. As in the previous observation regarding hyperglycemia, the 2007 Sree Chitra study" found as strong association between hypertension and young stroke When cases were compared with community controls as opposed to hospital controls.

In accordance with the study conducted in the Sree Chithra Institute", the strong association of the multiple components of the metabolic syndrome with stroke in young adults is a significant observation of the present study. Though such an association has been established in cases of older stroke patients, the same in young stoke patients adds to the growing body of evidence implicating insulin resistance, a precursor of the metabolic syndrome, in the development of vascular disease in young people of South Asian origin.

Summary and conclusions

The study was undertaken as a case control study among patients admitted to Dr SM CSI Medical College Hospital, Karakonam, 60 cases with young ischemic stroke and 60 matched controls were included in the study. Data regarding study variables was collected using a structured interview schedule, Data was analyzed using appropriate statistical measures. The following conclusions were arrived at.

- The median age of the study population was 37 years and 60% of the cases were aged more than 37 years. The study thus helps to zero in on the target population for instituting screening and preventive measures.
- 43 cases (71.66%) were males and 17 (28.33%) were females with a male to female ratio of 2.5. Males were found to have a significantly increased risk of young ischemic stroke compared to females. Most of the statistically significant risk factors were found to be more prevalent in males than in females.
- The intensity of work done by the patients as part of their profession viz. Heavy degree of labour, moderate degree of labour and mild degree of labour, was not found to significantly alter the chance of getting a stroke in the young. •
- Lower socioeconomic status and its frequent accompaniments viz. Illiteracy. Smoking and alcoholism probably predispose to young ischemic stroke
- 27 out of 60 cases (45%) were smokers compared to only 14 out of 60 controls (23%). Smoking was a statistically significant risk factor in the present study.
- Only 3 out of the 27 smokers (11.1%) were less than 30 years which may be an encouraging pointer to the declining trend of smoking in this age group.
- Though not statistically significant, 16 out of the 60 cases (26.66%) were alcoholics as per the criteria, compared to only 9 out of the 60 controls (%15%)
- None of the smokers or the alcoholics as per the criteria in the study was a female, Elevated total cholesterol (>200 mg/dl) was found to be a significant risk factor for young ischemic stroke, being found in 13 out of 60 cases (21.6%) compared to 4 out of 60 (6.6%) controls.
- Elevated triglycerides or LDL cholesterol was not found to be statistically significant risk factors for ischemic stroke in the young.
- Of the 60 cases, 45 (75%) had low HDL cholesterol compared to 31 out of 60 controls (51.6%). This was statistically significant.
- A statistically significant association was found between elevated post prandial blood sugar value and young ischemic stroke (*p* value 0.023) with post prandial hyperglycemia being found in 11 out of 60 cases (18.33%) compared to 3 out of 60 controls (5%).
- Waist circumference, Hemoglobin levels and ESR measurements were not significantly different in the group of 60 cases compared to the 60 controls.
- High systolic blood pressure was found to be a statistically significant risk factor for young ischemic stroke with 19 out of 60 cases (31.6%) having systolic blood pressure > 140 mm Hg compared to only 5 out of 60 controls (8.3%).

- 18 out of 60 cases (30%) had a diastolic BP 2 90 mm Hg compared to 5 out of 60 controls (8.3%) and this too was statistically significant (p value 0.003)

Future recommendations

- Community and hospital-based awareness programmes educating the general public and especially the youth about the potentially fatal effects of smoking. Programmes targeting the youth may be conducted in strategic places like colleges, universities, arts and sports clubs etc.
- Intensive campaigns, especially in hospitals, in the form of posters and billboards, announcing the health effects of smoking and excess alcohol.
- School health programmes may be arranged to stress on the need for healthy food habits, regular exercise, maintaining ideal body weight and to educate students regarding harmful effects of smoking, alcoholism and substance abuse
- Screening health camps both in schools and colleges for fundamental health check -up including, height and weight, BMI, blood pressure and blood sugar measurements.
- Encourage school and college goers to maintain a regular health chart and advise those with abnormal values to keep themselves in regular follow-up.
- Educate the parents of school-going children the potentially harmful effects of childhood obesity and enlighten them with the need for a regular exercise schedule for their children.
- Doctors may be trained to educate their hypertensive, diabetic and dyslipidemic patients to keep their children under regular follow-up to both identify and prevent these conditions in their wards.
- Distribution of tracts educating the general public about conditions like hypertension, diabetes, dyslipidemia, smoking, alcoholism, food habits, obesity and stroke. These may be distributed in schools, colleges, offices, railway stations and other public places.

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