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Review Article

Diet a modifiable risk factor for stroke: linking diet and stroke; an Indian perspective

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ABSTRACT

Stroke is the second leading cause of death and disability worldwide. The incidence of stroke in India has increased to hundred percent in past few decades. It was the Framingham heart study trial in 2001 which has first identified the role of dietary habits for prevention of atherosclerotic cardiovascular disease. Majority of secondary prevention strategies for Ischemic stroke are directed towards pharmacotherapy with antiplatelet and statins, while dietary modifications are not projected. However dietary and lifestyle modification can reduce stroke risk by 60%. Hence Diet and nutrition play an active role in prevention of stroke. This review summarizes the dietary intake, dietary patterns and risk of stroke among Indians and provides clinicians with pragmatic guidance to their management. We searched Pub Med, MEDLINE, for articles about diet and stroke in India published in English till May 2021. Diet plays a major role in pathophysiology of stroke. Modification of dietary pattern is the major non pharmacological treatment for the primary and secondary prevention of stroke. Indian traditional diet should be modified according to dietary pattern followed in each region. As a whole reduction of rice consumption, higher protein consumption and lower fat consumption should be encouraged at macronutrient level, while higher intake of fruits and vegetables are advised at micronutrient level. Dietary guidelines should be customized and tailor made based on the regional customs and annual income in various subsections of the society.

Keywords: Food, Nutrition, Salt, Stroke, Indian cuisines, Traditional diet

INTRODUCTION

According to the Indian Stroke Association December 2019, the burden of stroke has increased to 100%. The incidence is higher in rural areas (194-215 per 100,000 population) as compared to the national average (119-145 per 100,000 population). Stroke in India claims 119-145 deaths in every 100,000 population. Every year in India 1.8 million people suffer stroke.

Diet and stroke are interrelated. Health of an individual depends on the diet consumed. Healthy dietary habits play an important role in prevention of atherosclerotic cardiovascular disease (ACVD) as established in the Framingham heart study.1Modification in dietary habits and lifestyle changes can reduce risk of stroke by 60%.[2] However the scenario is different in India as there is no uniform diet or average diet followed by Indians. There exists diversity in dietary pattern in different parts of the country due to varied cultural, regional and religious practices. Hence developing and implementing dietary guidelines in India is a prodigious task.[3] This review summarizes the dietary habits, pattern of diet consumed by Indians and linking them to stroke by reviewing the Indian studies.

A descriptive review of the references were reviewed by searching the literature for the articles published in PubMed and Medline in English language using the

following MeSH words mostly related to Indian studies including "dietary pattern, diet and stroke, India, dietary habits, dietary culture of India, North and South Indian Cuisine, Dietary pattern and stroke studies India, Diets in stroke, stroke burden in India, rural and urban India, Eastern and western India dietary habits, macro and micronutrients, effects of dietary ingredients on stroke in India" till May 15 2021.

DIETARY PATTERNS IN INDIA

India has a rich and highly varied cuisine. Previous studies have used dietary surveys, measurement of food consumption, dominant food in the diet, clustering of food and change from traditional diet followed in a region to western diet to identify distinct dietary patterns in India. Given the diversity in soil, climate, culture, ethnic groups, and occupations, these cuisines vary substantially and use locally available spices, herbs, vegetables, and fruits.

Indians consider breakfast as an important meal. Tea and coffee is accompanied with breakfast in all regions of the country. North Indians mostly consume dishes prepared from whole wheat (roti), puffed rice (poha) along with green leafy vegetable dishes,4while south Indians prefer dishes prepared from rice flour (Idli,dosa) along with chutneys 5 prepared either from groundnut, coconut or tomatoes, for breakfast. Traditional lunch in North and west India consists of whole wheat roti's plus two to three kinds of vegetable curries and pickle. Depending upon geographical location, food preferences vary. Fish is a part of staple diet in coastal regions. However rice remains the main dish in the south and the eastern part of country. Dinner preferred in Northern India is usually prepared from wheat flour whereas South Indians prefer rice with spiced curries and curds. Most of the Indian families prefer to consume local Indian sweets after a heavy lunch and dinner on a regular basis.

RURAL VERSUS URBAN DIETARY HABITS

Increased urbanization has a tremendous impact on one's lifestyle and dietary preferences. This has led to an increased risk of obesity and non-communicable diseases. In a cross sectional study conducted in India, dietary intake and rural urban migration and their correlation have been extensively studied from march 2005 to December 2007 with 6509 participants, in 4 major cities of India (Bangalore, Nagpur, Hyderabad, Lucknow).[6] The median energy intake in the urban group was higher than rural group (3224 kcal versus 2153 Kcal respectively) for men and women (2644 kcal versus 2153 kcal respectively). Lower fiber content in the diet makes the rural population more vulnerable to stroke. It was also observed that meat and dairy intake were higher in migrant and urban participants than rural participants ($p<0.001$), however regional variations existed. Hence rural to urban migration and their dietary patterns appear to have both positive and negative effects on stroke. Influence of urbanization depends on food consumption, diversity based on infrastructure, market access, and percentage working women in urban areas, norms and institutions.[7]

DIETARY PATTERN STUDIES

Based on systematic review of published literature Rosemary Green et al identified forty one dietary patterns in India.[8] The most common food groups across all patterns were vegetables (16 out of 41 patterns), cereals (13 patterns), fruits (10 pattern), meat (9 patterns), pulses (8 patterns) and dairy products (8 patterns) respectively. Less frequent were snacks and sweets (6 patterns). They observed that sweets and snacks were more likely to characterise diets in the East and South India, whereas fruits and vegetables were more likely to characterise diets in the North and Western India. Meat or fish consumption were more likely to characterise diet from East and South than from North and West India. In another study done in 2019, Indian diet was compared to the EAT- Lancet reference diet.[9] The EAT-Lancet Commission diet consists of a large amount of vegetables, fruits, whole grain, legumes, nuts and unsaturated oils, some seafood and poultry, and little to no red meat, processed meat, added sugar, refined grains, and starchy vegetables. It was found that average daily calorie consumption is below the recommended 2503 kcal/capita/day across all income groups, except for the richest which forms 5% of the population. Calorie share of whole grain was higher while those of fruits, vegetables, legumes, meat, fish and eggs were significantly lower when compared to the EAT-lancet recommendation.

DIETARY PATTERN AND RELATIONSHIP WITH HEALTH OUTCOME

Dietary pattern and outcome of health depended on body size: body mass index (BMI), waist circumference or abdominal adiposity. It was found that high-fat and high - sugar foods such as sweets, snacks and animal products had significantly greater body size. Dietary pattern characterised by fruit, snacks and meat was associated with significantly smaller body size. Dietary pattern defined by consumption of vegetables, sweets, fruits, pulses, nuts, poultry and eggs had significantly lower cholesterol. Presence of snacks in dietary pattern has unfavourable risk factor profile, as snacks in India are usually high fat, high-salt fried foods. Traditional diet high in fruits, vegetables, pulses and nuts was associated with lower cholesterol and may have a healthier profile.[8]

DIETARY PATTERNS AND STROKE

Majority of stroke are Ischemic (80%) than Haemorrhagic. There exists multiple modifiable risk factors for Ischemic stroke, among them hypertension is the major risk factor for Ischemic and Haemorrhagic stroke from Indian stroke registries.[10-13] Other risk factors

were hypercholestremia, Diabetes Mellitus, alcohol consumption, smoking and sedentary life style. Healthy dietary pattern like low intake of salt and high intake of fruits which are rich in potassium can reduce hypertension. As the daily salt intake increases, there is increased risk of myocardial infarction (MI) and stroke (both Ischemic and haemorrhagic).[14] Asa consequences of MI, person is more prone for left ventricular dysfunction (LVD), low ejection fraction, left ventricular clot (LV clot), arrhythmia which in turn leads to cardio embolic stroke.[15] Hence change in dietary pattern and adapting a healthier diet can prevent primary and secondary stroke.

DIETARY PATTERN AND STROKE STUDIES FROM INDIA

There are only very few countable studies that linked dietary pattern and stroke from India. The first study that evaluated dietary pattern in stroke case was from Northwest India in year 2013.[16] In this study authors tried to explore the dietary patterns in stroke patients and attempted to establish a link between dietary patterns and stroke characteristics. A total of 210 stroke patients (Ischemic & haemorrhagic) were enrolled in this study and data was collected based on oral diet questionnaire. All patients consumed cereals and beverages (100%). Consumption of other food items in the diet were milk and milk products in 203 (96.7%) study subjects, saturated fats (butter, butter oil, cream) in 133 (63.3%) study subjects, bakery items in 139 (66.2%) study subjects, fried snacks in 116 (55.2%) study subjects, fruits in 96 (45.7%) study subjects, and juices in 20 (9.5%) study subjects. Significant proportion of the patients, i.e. 112 (53.6%) subjects consumed more food calories than recommended. Use of fried snacks was significant in patients who consumed alcohol (p=0.03) and patients who had diabetes mellitus were more likely to use saturated fats (p=0.01). This study from Northwest India (Ludhiana) concluded that stroke patients from Northwest part of India consumed mainly milk and milk products while fruits and juices formed small proportion of their diet. Hence a dietary modification of higher intake of fruit juices and lower consumption of milk products would reduce stroke risk in this part of country.

Another study to know the dietary pattern in adult patients with acute stroke was conducted in South India (Hyderabad).[17] This was a prospective case control study and 150 participants with first ever stroke (Ischemic and haemorrhagic) were compared with 150 age and sex matched healthy control.[17] Dietary habits and patterns of diet were obtained using a food frequency questionnaire with a list of 55 food items and how often it was consumed. Mean age of stroke patients in this study was 52.4±12.6 years. 68.6% patients had older onset stroke (>45 years) while 31.3% had early onset (age ≤45 years) stroke. This study in Hyderabad (urban region) showed that majority of stroke patients were on traditional diet (rice intake in 98.6%, pulses in 40.6%) with higher consumption of carbohydrate. Hyderabad study also observed a lower intake of green leafy vegetables, roots, tubers and fruits in stroke patients than healthy controls and this difference were statistically significant (p<0.05). Stroke patients also reported a higher intake of red meat, organ meat and a lower intake of prawn and crab when compared to healthy controls and the difference was significant. This study also observed, stroke patients had higher consumption of fried snacks (p=0.0038, OR 2.01), pickles (p=0.04, OR 1.81) and saturated fats (p=0.04, OR: 2.17). Higher alcohol consumption and lower water intake (<1 litre/day) was reported in stroke patient compared to healthy controls. Men had higher consumption of chicken and alcohol intake compared to women with stroke. Consumption of tender coconut water was very less among stroke cases.

Hence dietary modification in Hyderabad region (Telangana state: Southern part of India) is needed to prevent stroke. Higher consumption of green leafy vegetables, fruits, fish, and higher intake of water/day with lower intake of red meat, organ meat, snacks and pickles are the dietary modification advised to reduce the stroke risk. There is a dire need for similar studies to establish both local and national dietary guidelines and recommendations. Ultimately health depends on what we eat.

Stroke and Ischemic heart disease are leading cause of death in India. 4 Increased dietary intake of salt is a well-known risk factor for MI and stroke.[14,18,19] On an average, an Indian consumes between 8.5 g and 15 g per day of salt as compared to western population (average is 8.9 g per day amongst Americans).[20-22] A mathematical model for dietary salt reduction and cardiovascular disease rates in India was studied by Basu et al based on various Indian studies published earlier.[23] Based on their model they showed that people living in both urban and rural zones and both sexes were likely to benefit from reduction in dietary intake of salt and expected benefits were largest among young urban men. Reduction in dietary salt intake of 3 gm per day would cause a rise in iodine deficiency based on Indian studies. Thus utmost care is exercised to prevent iodine deficiency with this salt restriction.[24]

DIET AS A MODIFIABLE RISK FACTOR FOR STROKE

Diet plays a crucial role in the pathogenesis of stroke. Literature review showed that carbohydrate-rich diet causes obesity, and risk of developing diabetes mellitus Type II and higher consumption of dietary saturated fatty acid (SFA) is associated with stroke mortality in both the sexes.[25] Higher salt intake and red meat is associated with increased blood pressure, a significant risk factor for stroke.[26] Intake of green and yellow vegetables, fruits, and whole grains which are high in fiber content are protective against ischemic stroke.[27] Daily consumption of three or more cups of tea (green or black) is associated with a 21% lower risk of stroke compared to those who consume <one cup/day.[28]

COMPARISON OF TRADITIONAL LOCAL DIET WITH THE SPECIALIZED DIET

Specialized dietsare internationally accepted for stroke prevention. These include Mediterranean diet, DASH diet (dietary approaches to stop hypertension), and LCHF diet (Low carbohydrate high fat diet). The Mediterranean diet (Figure 1) is a diet with high intake of fruits, vegetables, cereals, nuts and olive oil; moderate intake of poultry, fish and wine; low intake of sweets, red meats and dairy products.[29] DASH diet (Figure 2) advocates higher intake of fruits and vegetables and low-fat dairy products in diet.[30] DASH diet lowers the blood pressure by 5.5 mm of hg systolic and 3 mm of hg diastolic blood pressure. PURE (prospective Urban Rural Epediomology) trial observed that higher intake of fat and animal protein caused lower mortality (Figure 3, LCHF diet) and higher carbohydrate consumption increased mortality in contrary to popular beliefs.[31] Literature showed traditional diet adopted in Northern and Western India were of one kind whilst that adopted in Southern and Eastern India was of a similar pattern. On comparing specialized diet with Indian traditional diet, higher intake of vegetables and fruits, and lower intake of refined carbohydrates (rice), salt, pickles and alcohol consumption in Southern and Eastern region of the India is recommended. On the other hand fish consumption should be encouraged along with lower intake of milk products in Northern and Eastern region of the country.

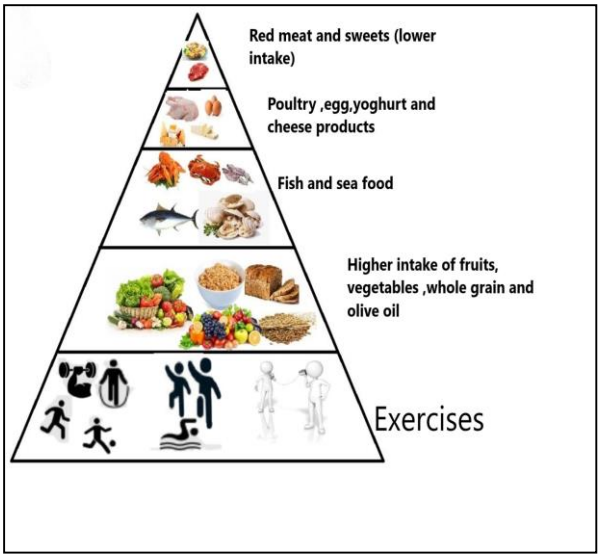

Figure 1: Mediterranean diet.

Reduction of salt intake daily per day would reduce hypertension and reduces cardiac risk factors also. Hence dietary modification or healthy diet are inter related and prevent major vascular risk factors and stroke subtypes. Intake of fruits causes increase consumption of potassium this in turn reduces blood pressure which in turn is major risk factor for stroke either Ischemic or haemorrhagic stroke.

Figure 2: DASH diet.

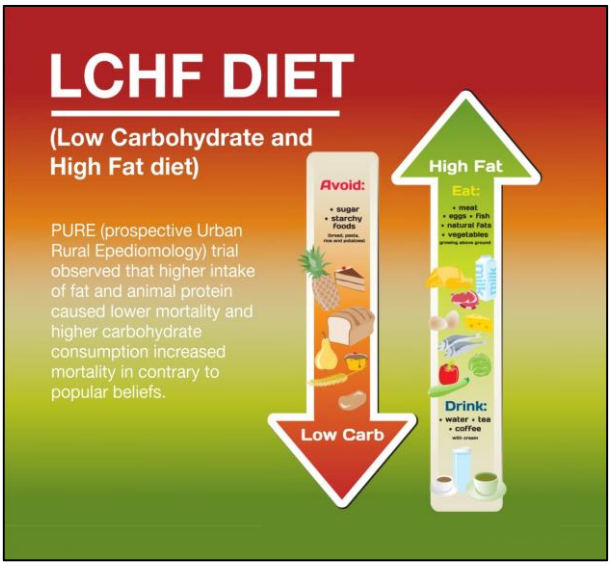

Figure 3: Low cholesterol high fat diet.

Low intake of sweets, red meats and dairy products as advised in Mediterranean diet prevents stroke. Reduction of sweets reduces carbohydrate levels in blood which in turn reduces blood sugar level thus preventing diabetes mellitus, obesity and metabolic syndrome. Red meat is a rich source of nutrition, but its constituents of heme iron and free iron are associated with chronic diseases. Red meat consumption has been related to cancers like colon and rectal cancers by the endogenous formation of intestinal carcinogenic N nitrosocompounds.[32] To overcome oxidative stress caused by free iron in red meat, it is advised to have excess fruits and vegetables with red meat intake which act as antioxidants.

Hyderabad study found that higher intake of red meat and organ meat were seen in stroke patients compared to healthy control and this differences were significant.[17] Red meat intake is also associated with neurological illness like depression.[32] In the new castle (UK) 85+ Cohort study it was found that a dietary pattern high in

red meat was associated with poor cognition over a follow up period of five years.[33] Uppsala seniors cohort study including 194 cognitively healthy individuals found that lower consumption of meat and meat products was linked with better cognition.[34]

Role of pure sodium salt on Neurological disorders was studied by Thakur from Dehradun India.[35] In India where consumption of natural salt (a rich source of magnesium) is still common, however urbanization and manufacturation of iodized salt removes micro and macro-minerals and trace elements from sea salt and rock salt and leads to substitution with pure sodium salt in regular diets. Sodium chloride (NaCl) causes major changes in electrolyte composition leading to impairment in functioning of Na-K pump, calcium pump and thermodynamic and biological functions of the body system. Hence there is an increase burden of neurological diseases like Alzheimer's, Parkinson's disease, other dementia, stroke, epilepsy and primary headache disorder.

Higher intake of fruits and vegetables causes reduced risk of stroke as cited earlier from various studies. Long term higher consumption of vegetables and fruits(total fruits) and fruit juice especially orange juice has beneficial role in late life subjective cognitive function.[36]

Fish intake improve cognitive ability in health people as fish is an important source of omega 3 fatty acids that are present in the membranes of the brain tissue.[37] Hence reduces risk of Alzheimer's dementia.

Diet plays a major role in pathophysiology of stroke. Modification of dietary pattern is the major non-pharmacological treatment for the primary and secondary prevention of stroke. Indian traditional diet should be modified according to dietary pattern followed in each region. As a whole reduction of rice consumption, higher protein consumption and lower fat consumption should be encouraged at macronutrient level, while higher intake of fruits and vegetables are advised at micronutrient level. Intake of liquids of three litre per day in form of water, coconut water and lassi would prevent dehydration and stasis of blood and clot formation. Additional salts used in pickles and pappads should be discouraged. All together with moderate exercise can help to control vascular risk factors of stroke and lead a life with late life normal cognition.

CONCLUSION

India being a developing nation and with wide cultural diversities and varying ethnicities, proposing a "Universal Diet" is a herculean task. Guidelines should be customized and tailor made based on the regional customs and annual income in various subsections of the society. However, certain recommendations can be followed universally viz. increased water intake, increased consumption of locally available fruits and vegetables, limiting consumption of saturated fats, dairy products, red meat and pickled food, encouraging consumption of fish, tea and whole grains. As the quote goes "eat better, not less" applies to one and all across the globe. Further randomized studies are warranted to propose better dietary recommendations to prevent stroke. Also customized dietary plan has to be formulated in those with additional risk factors like Diabetes, Hypertension and dyslipidemia.

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