

## Prevention of Cardiovascular Disease and Diabetes Mellitus In Low and Middle Income Countries

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**Abstract:** Hyperglycemia as a component of metabolic syndrome, appears to be an important risk marker of vascular disease in most developing countries which are under transition from poverty to affluence. Despite a moderate increase in fat intake and low rates of obesity, the risk of coronary artery disease (CAD) and diabetes is rapidly increasing in most of the developing economies. It is a paradox that in some of these countries the increased risk of people to diabetes and CAD, especially at a younger age, is difficult to explain by conventional risk factors. It is possible that the presence of new risk factors especially higher lipoprotein (a)(Lpa), hyperhomocysteinemia, insulin resistance, low high density lipoprotein cholesterol and poor nutrition during fetal life, infancy and childhood may explain at least in part, the cause of this paradox. The prevalence of obesity, central obesity, smoking, physical inactivity and stress are rapidly increasing in low and middle income populations, due to economic development. In high income populations, there is a decrease in tobacco consumption, increase in physical activity and dietary restrictions, due to learning of the message of prevention, resulting into reduction in coronary and stroke mortality. Hypertension, (5-10%) diabetes(3-5%) and CAD(3-4%) are very low in the adult, rural populations of India, China, and in the African sub-continent which has less economic development. However, in urban and immigrant populations of India and China, the prevalence of hypertension (>140/90, 25-30%), diabetes (6-18%) and CAD (7-14%) are significantly higher than they are in some of the high income populations. Mean serum cholesterol (180-200 mg/dl), obesity (5-8%) and dietary fat intake (25-30% en/day) are paradoxically not very high and do not explain the cause of increased susceptibility to CAD and diabetes in some South Asian countries. The force of lipid-related risk factors and refined starches and sugar appears to be greater in these populations due to the presence of the above factors and results into CVD and diabetes at a younger age in these countries. These findings may require modification of the existing American and European guidelines, proposed for prevention of CAD, in high income populations. Wild foods or designer foods (400-500g/day) substitution ([www.columbus-concept.com](http://www.columbus-concept.com)) for proatherogenic foods; in conjunction with moderate physical activity and cessation of tobacco, may be protective against deaths and disability due to CVD and diabetes in most of these countries.

**Keywords:** Risk factor, inflammation, fruit, vegetable, diet.

### INTRODUCTION

Coronary risk factors; such as hypertension, diabetes mellitus, tobacco consumption, hypercholesterolemia and obesity as well as coronary artery disease (CAD) are a major health problems in developed as well as in developing economies. Hyperglycemia as a component of metabolic syndrome or diabetes mellitus appears to be the major risk factor for vascular disease.

CAD was known to Indians around 600 BC, when great physicians Sushrut and Charak proposed that “overeating, excess of sleep, lack of exercise and anxiety may cause narrowing of channels in the body resulting into heart attack and death”. The risk of cardiovascular disease (CVD); hypertension, stroke CAD and diabetes mellitus, is changing dynamically around the world. In the South Asian sub-continent, where type 2 diabetes and CAD are highly prevalent, it is clearly apparent that people of South Asian descent, around the globe have the highest rates of premature CAD, with clinical manifestations occurring about 10 years earlier than in other populations [1-4]. Over the past 50 years, several studies involving several generations, have consistently

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shown that the incidence and mortality rates for CAD are 50-300% higher among overseas South Asians compared with compatriots of other ethnicities [5-13].

### CAUSES OF MORTALITY

In India [5], all causes mortality were; infectious diseases (41.1%, n=915) such as tuberculosis, pneumonia, chronic obstructive pulmonary disease, diarrhea/dysentery, hepatitis B, inflammatory brain infections as the commonest cause of deaths in the urban population of north India. The second most common causes of deaths were circulatory diseases (29.1%, n=646) including heart attacks (10.0%), stroke (7.8%), valvular heart disease (7.2%, n=160), sudden cardiac death and inflammatory cardiac disease, each (2.0%, n=44). Malignant neoplasm (5.8%, n=131), injury (14.0%, n=313) including accidents; fire and falls and poisonings, were also quite common causes of death. Miscellaneous causes of deaths were noted in 9.1%, (n=202) death records, including diabetes mellitus (2.2%, 49), suicides (1.8%, n=41), congenital anomalies (1.0, n=37), dental caries infections (1.9, n=42), and burns (1.3%, n=33). Pregnancy and perinatal causes (0.72%, n=15) were not commonly recorded in our study. Circulatory diseases as the cause of mortality were significantly more common among higher social classes 1-3 than in lower social classes 4 and 5 who died more often, due to infections. Heart attacks, stroke, hypertension, diabetes and obesity were significantly more common among higher social classes 1-3 compared to class 3 and 4 but tobacco intake showed only minor differences in various classes.

In one Indian report [7] in the year 1994 to 1998, trends indicate that there has been a significant decline of proportionate deaths from infectious diseases from 22% to 16%. Cardiovascular disease (CVD) mortality increased from 21% to 25%. This is lower than death rate of 29.1 reported by Singh *et al.* in 2005 [5]. In a recent verbal autopsy among 48,357 adults aged 25-69 years at Chinnai, deaths due to vascular diseases were 38.6% (n= 18,680), followed by cancer (8.7%), tuberculosis (5.8%), and respiratory causes (3.5%). There were 1,354 deaths in another verbal autopsy study among 150,000 subjects, in the first year follow up. This study showed that circulatory diseases as the cause of death were noted in 34% men and 30% women. In a selected urban population from south India (9) among 1399 subjects (respondents 1262). Deaths were significantly greater among diabetics compared to nondiabetics (18.9 vs 5.3 per 1000 person years, P=0.004) during a follow up of 6 years. Mortality due to CVD were 52.9% among diabetics and 24.2 among nondiabetics. is an urgency for prevention program due to increased burden of CVD in type 2 diabetes in India [4-11]. Conventional risk factors common among Indian immigrants to industrialized countries are not able to explain the cause of higher risk of CVD mortality among these populations [11-14]. International College of Cardiology, The Tsim Tsoum Institute, Poland, Indian Society of Hypertension and International College of Nutrition and other experts have proposed guidelines for prevention of CVD and diabetes in Indians and Asians. These guideline are modifications of the American guidelines so they can be used for public education by the health workers all over the world [15-21].

### PREVALENCE OF HYPERTENSION, TYPE-2 DIABETES AND CORONARY ARTERY DISEASE

In 2007, world population was 6.6 billion including 1.3 billion South East Asians, which would increase to 7.9 billion and 1.6 billion respectively by the year 2025. The population of adults, aged 20-79 years, was 4.1 billion in the world in the year 2007. This included 770 million South East Asians, which would increase to 5.2 billion and 1083 million respectively by the year 2025. In South East Asia, in the year 2007, the prevalence of diabetes and prediabetes were about 6% each indicating that 46.5 million subjects above 20 years had this problem which would be doubled by the year 2025. The burden of CAD would be similar but hypertension would be 4 fold greater compared to diabetes. According to new criteria, the prevalence of hypertension (>140/90 mmHg) has been reported to be 22-30% in India among urban subjects above 20 years of age. In various cities according to nutritional status, the prevalence of CAD varies between 8% to 14%. In rural population, the prevalences of diabetes, hypertension and CAD is 2-3 fold lower compared to urban communities [22-32].

### HYPERTENSION

Of 600 million adults, 420 million were rural and 180 million, urban in a 2001 census. The absolute number of hypertensives (>140/90) would be 31.5 million rural and 34 million urban, (total=65.5 million). Stage 1, hypertension (>140-159/90-99) 45.5 million pre-hypertension (130-139/85-89) with 20% prevalence; 50 million. It may be estimated that 50 million subjects may diagnosed with prehypertension. These patients should be educated about lifestyle changes to prevent the development of hypertension. Drug therapy with ACE-inhibitors and and amlodipine calcium channel blocker may be given to rest 65.5 million along with lifestyle changes.

Table 1-5 reveal the prevalence of hypertension in India. The prevalence of hypertension was 6.8% in rural Haryana to 21.2% in rural Rajasthan. The prevalence was significantly greater in urban Trivandrum, South India compared to Moradabad in North India (Table 1). [23, 24, 27] Table 2 indicate that mean blood pressures of the population increased from 73.2 mmHg diastolic in 1942 to 84.0 in 1997. The systolic mean blood pressure was 120.4 mmHg in 1942, which increased to 130 mmHg in 1997.

Mean systolic blood pressure was 125mmHg and diastolic 82 mmHg in an urban women sample of 3212 subjects aged 25-64 years, as observed in the Five City study. Hypertension (>140/90 mm Hg) was significantly more common in south India and west India, compared to east, central and north India (Table 3). However, the overall prevalence of hypertension in the five cities was 25.6% (n=823) among women (Table 4). Isolated systolic hypertension 2.9%(n=96), borderline, 14.9%, isolated diastolic hypertension 50.5%, definite hypertension 18.6% were also common. It seems that hypertension and its risk factors, have become an important public health problem in India. This is more clear from the data observed in the Five City Study (Table 1-4).

### BLOOD PRESSURE VARIABILITY

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**Table 1. Prevalence of Hypertension in Rural and Urban Population of India (>140/90)**

Authors	Year	Age,	State	No of subjects	Prevalence
Rural					
•Hussain <i>et al.</i> ,	1988,	20-70	Rajasthan	5142	6.8%
•Gupta <i>et al.</i> ,	1994	20-80	Rajsthan	3148	21.2%
•Singh <i>et al.</i> ,	1997	20-65,	UP,	162	12.9%
•Singh <i>et al.</i> ,	1997	25-64,	UP	1702	17.3%
Urban					
•Wasir <i>et al.</i> ,	1995	20-75	Delhi	679	6.2%
•Gupta <i>et al.</i> ,	1997	20-65	Rajasthan .	2212	31%
•Singh <i>et al.</i> ,	1997	20-65	Moradabad	152	32.8%
•Singh <i>et al.</i> ,	1997	25-64	Moradabad	1806	26%
•Singh <i>et al.</i> ,	1998	25-64	Moradabad	3212	25.6%
•Begum <i>et al.</i> ,	1998	25-64	Trivandrum	1497	30.7%
•Singh <i>et al.</i> ,	2010	>25	Five cities	6940	28.9%

Modified from Singh *et al.*, 2000.**Table 2. Rise in Mean Blood Pressure from 1942 to 1997 Among Adults in India**

Authors	Year	Systolic	Diastolic
•Chopra,	1942,	120.4,	73.2
•Dotto,	1949,	121.6	82.0
•Dubey,	1954,	123.5	82.5
•Mathur,	1963	126.2	79.4
•Malhotra,	1971	126.2	79.4
•Sharma,	1985	128.7	84.2
•Gupta	1995	128.8	83.2
•Singh,	1997	130.0	84.0
*Singh <i>et al.</i> ,	2011	132.2	85.5
•Correlation Coefficient =0.98, 047,P<0.001 for Systolic ,=0.47 for diastolic,P<0.021			

Modified from Singh *et al.*, 2000.**Table 3. Prevalence of Hypertension in Five Indian Cities**

•Area	>140/90	>160/95	Prehypertension
•North,Moradabad	22.3%	12.9%	24.6%
•South,Trivandrum	30.7%	18.1%	32.2%
•East,Calcutta	19.1%	11.8%	21.3%
•Central,Nagpur	24.2%	12.3%	25.7%
•West,Mumbai	28.0%	17.0%	30.1%

Modified from Singh *et al.*, Int J Cardiol, 1998.

Medical School, Minneapolis, USA discovered new criteria for the diagnosis of vascular variability disorders (VVDs); circadian-hyperamplitude tension, MESOR hypertension and ecphasia. South Asians living in USA appear to have significantly greater risk of VVDs compared to Caucasians. Population surveys should be conducted with ambulatory blood pressure monitoring to demonstrate VVDs among various communities of the world.

**Table 4. Risk Factors of Hypertension in Five Indian Cities**

RiskFactors,	Hypertensive	Normotensive
•Mean age,yrs (SD)	44.2(15)*	36.8(12)
•BMI,Kg/M2, (SD)	24.2(2.7)**	22.2(2.7)
•Sedentary,	89.9% **	40.9%
Salt intake	87.9% *	47.8%
•Alcohol	20.5%*	5.2%

Modified from Singh *et al.*, 2007.

## TYPE 2 DIABETES MELLITUS

Table 5, shows the prevalence of type 2 diabetes mellitus which was quite low before 1984 among both rural (1.6 2.4%) and urban (3.4-4.5%) populations of India. The prevalence of diabetes showed marked increase in the last two decades in India and other developing countries. Type 2 diabetes was; 5% at Kudremukh as observed by Ramchandran *et al.* in 1988 which increased to 14.3% in Madras by 2006 (Table 5). Insulin resistance appears to be a risk factor of type 2 diabetes, hypertension and CAD among South Asians [36-38].

## CORONARY ARTERY DISEASE

People of South Asian origin wherever they are living develop clinical manifestations of coronary atherosclerosis at a younger age which often have a malignant course [34, 35]. It is noteworthy that, about 50% of the first MI occur before the age of 55 years and 25% occur before 40 years of age. South Asians in England, younger than 30 years of age, have 3 fold higher CAD mortality than whites and in Singapore, 10-fold higher deaths than Chinese. The risk factor adjusted CAD rates are two fold greater among overseas south Asians

**Table 5. Prevalence of Type-2 Diabetes in India**

Year	Author	Place	Urban %	Rural%
1971	Tripathi <i>et al.</i> ,	Cuttack(Central)	1.2	-
1972	Ahuja <i>et al.</i> ,	New Delhi(North)	2.3	-
1979	Gupta <i>et al.</i> ,	Multicentre	3.0	1.9
1984	Murthy <i>et al.</i> ,	Tenali(South)	4.7	-
1986	Patel Bhadran	(West)	3.8	-
1988	Ramchandran <i>et al.</i> ,	Kudremukh(South)	5.0	-
1989	Kodall <i>et al.</i> ,	Gangavathi(South)	-	2.2
1989	Rao <i>et al.</i> ,	Eluru(South)	-	1.6
1991	Ahuja <i>et al.</i> ,	New Delhi(North)	6.7	-
1992	Ramchandran <i>et al.</i> ,	Madras(South)	8.2	2.4
1995	Singh <i>et al.</i> ,	Moradabad	7.9	2.5
1997	Ramchandran <i>et al.</i> ,	Madras(South)	11.6	-
1998	Singh <i>et al.</i> ,	Moradabad	6.0	2.9
2000	Rammurthy <i>et al.</i> ,	Kerala(South)	12.4	2.5
2001	Ramchandran <i>et al.</i> ,	National(DESI)	12.1	-
2001	Iyer <i>et al.</i> ,	Dombivill	6.2	-
2004	Sadikot <i>et al.</i> ,	National	5.9(4.3)	2.7
2006	Mohan <i>et al.</i> ,	Chennai	14.3	-
2006	Menon <i>et al.</i> ,	Chennai	19.5	-
2008	Kumar <i>et al.</i> ,	Kolkatta	11.5	-
2011	Singh <i>et al.</i> ,	Moradabad	7.5	2.8

Modified from Ramchandran 2007.

compared to Caucasians [1-4, 17-35]. There has been a ten fold increase in the prevalence of CAD in the last three decades in the urban population of India and it appears to be as common as in developed countries. In rural areas, a three fold lower prevalence of CAD has been observed compared to cities.

In both rural and urban subjects, the prevalence of CAD was higher in South India, compared to North India. According to a study conducted in five different corners of India, CAD has become an important concern in south Asia. Compared to rural areas, CAD was three fold more common in

the urban north India at Moradabad (9.0%), four fold more common in urban south Indians at Trivandrum (13.9%), and Mumbai (11.6%), in west India, Nagpur (10.0%) in central India and Kolkotta(8.2%) in east India. Social classes 1-3, have greater risk of CAD, type 2 diabetes and hypertension, than lower social classes in both rural and urban populations of south Asia. We have reported a paradox paradox that dietary intakes and physical activity explain only a part of differences in prevalence and risk of CAD, hypertension and diabetes in people of south Asia wherever they are living (Table 6-8).

**Table 6. Prevalence % of Coronary Artery Disease and Coronary Risk Factors in South Asians and British**

	North Indians		South Indians Urban	Sri Lanka Urban	UK South Asians	Native British
	Rural	Urban				
Coronary Artery Disease	3.0	9.0	13.9	11.5	15.0	6.0
Smoking (%) (Men)	30.2	5.6	44.6	57.4	22	30
Diabetes (%)	2.3	6.0	12.0	5.8	19.0	5.0
Hypertension (<140/90 mmHg) (%)	10.0	25.0	30.0	27.2	28.0	30.0
Total Fat (kcal daily)	14.8	24.7	28.8	28.0	38.8	42.2
Saturated Fat (% kcal daily)	4.9	9.2	14.4	13.6	13.7	18.5
Cholesterol in diet (mg daily)	53	166	240	210	200	405
Body Mass Index (kg/m <sup>2</sup> )	21.6	22.9	22.7	21.0	26	26
Waist-Hip Ratio (Male)	0.86	0.89	0.89	-	0.98	0.94
Fasting Plasma Insulin (Male) (mU/L)	4.8	5.1	16.6	-	9.8	7.2
2-Hour after Glucose (mU/L)	11.8	24.2	60.6	-	41.0	19.0
Serum Cholesterol (mg/dl)	168	190	210	196	230	236
HDL Cholesterol (mg/dl)	43.5	44.2	45.1	45.2	45.0	46.2
Angiotensin Converting Enzyme (IU)	37.5	63.4	72.0	-	80.0	-
TNF-alpha(pg/ml)	4.5	15.6	18.8			
IL-6(pg/ml)	2.8	11.5	14.4	-	-	-
Nitrite(umol/L)	1.0	0.76	0.67	-	-	-

Values are means, Modified from Singh *et al.*, [24] Lancet, 1995, J Nutr Environ Med 2001, Biomed Pharmacol 2004. HDL = High Density Lipoprotein Cholesterol.

**Table 7. Genetic and Other Specific Risk Factors Common in South Asians for Unexplained Heart Disease**

Genetic or Environmental	Other Risk Factors
1. Insulin resistance and hyperinsulinemia	1. Increased plasminogen activator inhibitor-1
2. Poor beta cell function	2. Decreased tissue plasminogen activator
3. Increased prevalence of type II diabetes	3. Decreased antioxidant vitamins A, C, beta-carotene, E, Se, Zn, flavonoids, other polyphenolics, amino acids.
4. Increased lipoprotein(a)	4. Low high density lipoprotein cholesterol
5. Increased angiotensin converting enzyme	5. Elevated homocysteins
6. High Apo-B	6. Low Apo A1
7. Influence on methylation of genes by betain, vitamin B12, folic acid and w-3 fatty acids.	7. Increased heart rate and BP variability
	8. Increased small dense LDL cholesterol
	9. Increased w-6/w-3 ratio in the diet. 1:50 due to increased intake of sun flower, corn and soya bean oils.

**Table 8. Dietary Guidelines and Desirable Level of Risk Factors for Indians**

Factors	Desirable Values
Energy (k calories/day)	1900-2300
Total Carbohydrate (k calories/day)	65.0
Complex Carbohydrate ((k calories/day)	55.0
Total Fat (k calories/day)	21.0
Saturated Fatty Acids (k calories/day)	7.0
Polyunsaturated Fatty Acids (k calories/day)	7.0
Polyunsaturated/Saturated Fat Ratio	1.0
n 6/n-3 Fatty Acid Ratio	1:1
Dietary Cholesterol (mg/day)	100
Whole Grains (wheat, rice, corn, legumes) (g/day)	400-500
Fruit, vegetables and nuts (g/day)	400-500
Salt (g/day)	<6.0
Brisk Walking (km/day)	9.0
Meditation/pranayam (minutes/day)	30.0
Body Mass Index (kg/m <sup>2</sup> )	
Range	19.0-23.0
Average	21.0
Waist-Hip Girth Ratio	
Male	<0.88
Female	<0.85
Serum Total Cholesterol (mg/dl) (4.42 mmol/L)	<170
Mild Hypercholesterolemia (mg/dl) (4.42-5.20 mmol/L)	170-200
Hypercholesterolemia (mg/dl) (>5.20 mmol/L)	>200
Low Density Lipoprotein Cholesterol (mg/dl) (2.32 mmol/L)	<90
Borderline High (mg/dl) (2.32-2.84 mmol/L)	90-110
High (mg/dl) (2.84 mmol/L)	>110
Triglycerides (mg/dl) (1.7 mmol/L)	<150
High Density Lipoprotein Cholesterol (mg/dl) (0.9 mmol/L)	>40 men, >50women
Blood Pressure (mmHg)	<135/88
Drug therapy in view of high risk of diabetes and CAD.	Ambloodipine,ACE-I , receptor blockers and new beta-blockers? Fish oil,aspirin, statins,nicotinic acid, fibrates.

Modified from Indian Consensus Group, J Nutr Environ Med, 1996, World Heart Journal 2009.

## RISK FACTORS

CAD rates are similar among both vegetarians and non-vegetarians among people of south Asia. Interestingly, Western vegetarians tend to have very low rates of CAD which may be due to increased intake of fruits and vegetables by these populations. The increased risk of south Asians to CAD and type 2 diabetes may be due to a possible molecular susceptibility. The western vegetarian diet is rich in fruits and vegetables, and non-vegetarian diets are rich in trans fat, saturated fat, w-6 rich oils and cholesterol as well as refined carbohydrates which may be proinflammatory. The Indian vegetarian diet is grain based with some vegetables. In urban areas, refined bread, biscuits, candies, syrups, sweets, milk products; butter (saturated fat), clarified butter

(Cholesterol oxide) and vegetable ghee which is trans fatty acids as well as w-6 rich oils; sunflower, corn and soya bean oil are commonly used in the diets. These foods are known to have proinflammatory effect resulting in to increased risk of CVD and diabetes. Decline in beta cell functions, insulin resistance, and hyperinsulinemia, increased prevalence of type 2 diabetes, increased Lp (a), increased plasminogen activator inhibitor-1 and apo B lipoprotein, higher VLDL and low HDL cholesterol appear to be important in increasing the risk of CAD and diabetes in south Asia (Table 7). Higher levels of tumor necrosis factor-alpha, interleukin 6, interleukin-18 and high sensitive C-reactive proteins, angiotensin converting enzyme activity (39.5+4.6 vs 65.5+ 7.8 IU, P<0.03) in rural and urban subjects respectively, have been proposed to be important new risk factors of CVD and

diabetes in Indians [3, 15, 16, 21-41]. High activity of ACE observed in Indian urban populations poses the possibility that ACE-I, could be important in the prevention of CVD and diabetes among south Asians. The risk, extent and prevalence, of atherogenesis, case fatality in acute coronary syndrome and mortality due to CAD is higher in south Asia, although they have low total cholesterol (150-200mg/dl), low body mass index (21-23Kg/M<sup>2</sup>), low fat intake (21-30% en/day), lower prevalence of hypertension, lower prevalence of obesity (5-7%), and moderate smoking among Asians, (compared to Caucasians), [25-41].

Populations adapted to survive in scarcity, on low fat intake and physically demanding occupations may develop conservatory mechanisms during transition from poverty to affluence [42-44]. Therefore, low intake of w-3 fatty acids, coenzyme Q10, antioxidant vitamins, essential amino acids and phytochemicals and high intake of w-6 fatty acids (w-6/w-3 ratio>50) and refined carbohydrates may predispose these communities to CVD and diabetes at modest increase in the primary risk factors which rapidly increase the secondary risk factors. In several randomized, controlled intervention trials, Singh and coworkers used 400g/day of fruits, vegetables, and legumes in conjunction with mustered oil to decrease the risk of hypertension, diabetes and CAD in 1090s [45]. DASH investigators in their studies re-examined this diet, to decrease the risk of hypertension in United States, [46, 47]. Singh observed that increasing dietary potassium and magnesium intake may increase tissue levels of these nutrients causing reduction in blood pressures.

In further trials, Singh *et al.* provided 400g/day of fruits, vegetables and nuts (almonds and walnuts) and another 400g/day of whole grains including legumes in conjunction with 25-50g/day of mustered oil in patients with high risk of vascular disease. These studies reported significant benefit due to increased intake of phytochemicals [48-50]. Other workers also found a beneficial effect of fruit, vegetables, nuts and w-3 fatty acids rich foods on risk of CVD [51-67]. Mono-unsaturated fatty acids and w-3 fatty acids have been suggested to be protective against diabetes and metabolic syndrome [62-66]. However, greater intake of trans fatty acids, saturated fat and refined starches can predispose CVD and diabetes [42-67]. Rapid economic development in south Asia is associated with higher intake of salt, tobacco, fat, sugar, omega-6 rich oils and energy in the last forty years. Increase in per capita income, gross domestic product, food production and automobile production in the last four decades have also been observed with increase in socioeconomic status. There have been marked changes in diet and lifestyle, during the period of 1970 to 2010, particularly in the urban populations, which may be the cause of the epidemic of CVD and diabetes among middle and higher income populations [2-10].

## GUIDELINES FOR PREVENTION

The diet and lifestyle guidelines for prevention of CAD, hypertension and diabetes mellitus by the American agencies and WHO have been of great interest for the last few decades. American Diabetes Association and AHA, as well as by WHO guidelines have been reformed for better understanding, based on new scientific evidence which has

emerged after their publication in 2000. Most US health agencies as well as by WHO have altered the targets for ideal blood pressure, blood glucose and blood cholesterol depending upon new evidence. These guidelines do not appear to be final and are likely to be altered in near future.

Most of the agencies do not emphasize on the role of diet in patients with acute myocardial infarction (AMI) [68-70]. AMI patients, due to their serious condition, are highly motivated to follow what is being advised by the cardiologist. It is easy to change health behaviours of the victims when they are admitted in the intensive cardiac care unit, to follow the same diet when they go back home. Hyperglycemia, hyperinsulinemia, hypertriglyceridemia, free radical stress, rise in free fatty acid and proinflammatory cytokines, leading to endothelial dysfunction are common in AMI patients [67-76]. There is an acute generation of proinflammatory milieu among AMI patients which is known to cause disruption of atheroma plaque, resulting into reinfarction and death [2-4].

Dietary patterns; including grains, vegetables, fruits, nuts, seeds and legumes, fat and oils based on two renowned studies, have been advised by the American experts [68, 75]. Since refined starches are known to cause endothelial dysfunction, this recommendation is no more given [69, 70]. It is important to provide advise on the type of oil and type of nuts containing w-3 fat and monounsaturated fatty acid (MUFA) content of these foods. Refined starches, added sugar as well as excess of w-6, total and saturated fat and trans fatty acids are proinflammatory. However, increased intake of w-3 fatty acid and MUFA may be protective against surge of TNF-alpha, IL-6, IL-18 and adhesion molecules like VCAM-1 (vascular cell adhesion molecule-1) and IVAM-1 caused by high glycemic, rapidly absorbed foods [71-76]. Such foods may initiate a proinflammatory milieu in the body which is similar to that of AMI and diabetes mellitus, causing further increase in complications, among these patients.

The Columbus Paradigm Institute ([www.columbus-concept.com](http://www.columbus-concept.com)) and the the Tsim Tsoum Institute ([www.tsimtsoum.net](http://www.tsimtsoum.net)) have proposed a low w-6/w-3 ratio and poly-unsaturated/saturated fatty acid ratio in the diet of 1:1 for prevention of dyslipidemia and CAD. It seems that this weakness in the guideline may be due to missing of related work [54-58, 71-75]. The greatest weakness of the American guidelines is that there is no discussion on proinflammatory foods, so there is opportunity for the industry to influence the consumers without consideration of their health.

Whole grains, vegetables, fruits, nuts and fish are good for prevention of obesity, hyperlipidemia, inflammation and hypertension as well as for prevention of dyslipidemia and metabolic syndrome and CAD. These foods inhibit the rise in FFA, hyperglycemia and maintain good endothelial function [74, 75]. Dietary cholesterol recommendations, are overemphasized, although it is well known that it has minor influence on atherothrombogenesis of serum LDL. Columbus foods are natural foods, rich in phytochemicals which are slowly absorbed without causing any abnormal increase in blood glucose, insulin, proinflammatory cytokines and free fatty acids and can decrease atherogenesis of LDL [74, 75]. A return of alpha-linolenic acid (ALA, C18:3 $\omega$ 3) in the diet- herein referred to as *wild-* or *game-*type land-based

fatty acid - into the feed ration of land-based bred animals to such an extent that their fat depots (white adipose tissue) exhibit a balanced ratio of *essential* fatty acids, i.e.  $\omega 6:\omega 3 = 1:1$ , is the basis of Columbus® concept. It is a characteristic of fat depots in wild animals or game.

This alteration may cause a substantial reduction in long chain omega-6 fatty acids and a moderate species-specific increase in long chain omega-3 fatty acids in organs and peripheral tissues of these domesticated animals or livestock. It seems that in all eatable fats, the  $\omega 6:\omega 3 = 1:1$  ratio should be taken as reference for the design of composite plant-derived table oils and fats for cooking and grilling of foods. These oils represent other primary sources of energy in the modern human diet but a particular attention is drawn to the antioxidant and essential amino acid content of such foods. The end results may be a return to animal and plant food supplies in better compliance with human genetic heritage and a possible rehabilitation of dietary cholesterol and saturated fats (former CSI, C: Cholesterol, S: Saturated fats, I: Index).

The Columbus® Concept stands for the return of a specific healthy cholesterol into men's food supply and blood stream, which may be called wild or game cholesterol that is associated with a dietary balanced essential fatty acid ratio ( $\omega 6:\omega 3 = 1:1$ ) [54-58]. In a natural untamed environment, nature recommends the consumption of a balanced ratio of saturated and polyunsaturated fatty acids as part of a dietary lipid pattern rich in monounsaturated fatty acids (P:M:S = 1:6:1). It has also been proven in long term dietary trials [39, 44-54, 60, 74]. Recently, US department of health and human services has issued guidelines for physical activity for Americans which need assessment by this joint consensus for application in South Asians [76, 77]. Cornelissen *et al.* have suggested the need for consideration of blood pressure variability disorders [78] and others about extent of type 2 diabetes mellitus [79]. In one experience (RBS), eating 50-60g/day of walnut caused significant reduction in blood pressures from 141/92 mm Hg to 130/ 88 mm Hg in about 8 weeks [80]. In several recent studies, a role for dietary patterns has been proposed in CVD and diabetes [80-90].

In brief, eating 400g/day of fruits, vegetables and nuts (almonds and walnuts 50g/day), another 400g/day of whole grains including legumes in conjunction with 25-50g/day of mustered oil or Columbus oil (olive oil+lin seed oil) may be protective for prevention of type 2 diabetes, hypertension, stroke and CAD. (Table 8) Regular spot running and meditation (each 30min) and cessation of tobacco intake are also important for prevention of these diseases. Alcohol intake in moderation, particularly red wine rich in reveratrol flavonoids may be more beneficial as proposed in the French paradox by Searge Renaud [80-84]. These diet and lifestyle changes can influence mind-body connections and have been better approached in the Tsim Tsoum concept which is an extension of the Columbus concept [54, 85]. Such diets and lifestyle have also been advised in ancient India and China and by WHO.

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