

Economic Implications of Preventive Cardiology : Indian Perspective

S Dwivedi and Ramesh Aggarwal***

Departments of Medicine/ Preventive Cardiology,
University College of Medical Sciences* and
Lady Hardinge Medical College**, Delhi

Abstract

India, which had been fighting the problems of infectious and nutritional diseases in the past is now facing the challenge of cardiovascular diseases (CVDs) such as hypertension (HTN), coronary artery disease (CAD), type 2 diabetes mellitus (T2DM), stroke, obesity and metabolic syndrome. It is well known that south Asians are more prone to vascular diseases mainly HTN, CAD, T2DM and stroke. These diseases have now slowly but steadily crept into the poorer segments of the society and that too amongst the most productive and working force of the country. Number of people affected with HTN, CAD, T2DM, stroke, and rheumatic heart disease (RHD) works out to be around 268.7 million based on current prevalence and 2001 census. RHD with its attendant complications continues to be our problem. Unfortunately, the number of studies that report health costs of these diseases is quite few in India. This article tries to address this issue with regard to the economic burden of CVDs in India and provides an overview of the resultant economic loss if they are not timely prevented.

According to the most conservative estimate the approximate cost of treating CVDs diseases particularly HTN, CAD, T2DM , stroke, and RHD, in India would be around Rs 3178.1 billion whereas if simple and practical life style measures are adopted to prevent these diseases the burden would be reduced to a mere Rs 615.7 billion. This huge

saving of Rs. 2562.4 billion will provide an answer to the big question: what is best: Prevention or Cure? Lest we adopt preventive measures right now at community and individual levels the direct and indirect health economic toll due to man days lost and social support will be devastating for our economy. Further, the economical implications of obesity, metabolic syndrome and stroke in the population < 40 years mandate in depth research.

Key words: Economics of prevention, coronary artery disease, hypertension, type 2 diabetes mellitus, stroke, metabolic syndrome, rheumatic heart disease.

Introduction

Cardiovascular Diseases (CVDs) particularly hypertension (HTN), type 2 diabetes mellitus (T2DM), coronary artery diseases (CAD), rheumatic heart diseases (RHD), obesity and metabolic syndrome have emerged as a major cause of morbidity and mortality in developed as well as developing countries. India with its population crossing the one billion mark (1) is facing major brunt of these diseases on account of several reasons like (a) changes in life style consequent to economic improvement, migration to cities and urbanization (b) ageing (c) ethnicity (d) increasing population (2). If the current rising trend of these CVDs is not contained well in time it is feared that the bare minimum cost of managing and treating these diseases will be beyond the economical means of our resources.

It is also to be appreciated that due to unprecedented technological advances in medicine and cardiology a mad race for providing tertiary care treatment for CVDs has taken a front seat, while preventive strategies remain more or less ignored. Corporate-sponsored medical emporia have flooded the entire developing world and the glamour for interventional cardiology is further compromising the basics of preventive measures which may be more useful for preventing its further spread in an individual as well as society at large (2).

The economic implication of treating the CVDs particularly CAD and T2DM when fully developed is enormous. The situation turns more serious when we realise that, this epidemic is also affecting the most productive age group of the country i.e. the incidence of CVDs among

population less than 40 years is increasing (3).

This paper aims to illustrate the current CVD burden and its impact on Indian economy and an urgent need to adopt the simple and practical measures to prevent this epidemic and its effect on overall national economy.

Burden of Cardiovascular Diseases (CVDs)

During the last four decades cardiovascular diseases have been steadily increasing and over the time they have affected approximately 1.5-26.5 % of the Indian population albeit more in urban areas compared to rural population. Most important aspect of

this scenario is that most of these illnesses are preventable. (Table 1)

It is estimated that India presently has 35.8 million of CAD, 200 million of HTN, 1.2 million of CVA (stroke), 31.0 million of T2 DM and 0.7 million of RHD (Table 2). These figures have been derived from the current prevalence rate and assuming total population as derived from 2001 census to be 1027 million. Though a tentative prevalence rate of obesity and metabolic syndrome have been calculated on the basis of recent studies done in urban cities, however hard figures regarding their prevalence in rural and urban areas both need to be worked out.

Table 1: Prevalence Trend of Cardiovascular Disorders (CVDs) in India

| Disease | 1950-1970 | 1970-1980 | 1980-1990 | 1990-2000 | 2000 onwards |
|-------------------------|-----------|-----------|-----------|-----------|-----------------------|
| CAD (4) | 5.5% | 6.5% | 9.7% | 10.9% | 11% |
| HTN (5,6) | 1.2% | | * | | 20% |
| DM (7,8,9) | 2.1% | 2.3% | 12.1% | 13.5% | 14.3% |
| CVA (10) | * | | | | 0.9-2.2 /1000 persons |
| Obesity (11) | * | | | | 26.5% |
| Metabolic syndrome (12) | * | | | | 25.8% |
| RHD (13,14) | 1.8-11 | 1.8-11 | 1-3.9 | 1-3.9 | 1.5-4 |

* The exact prevalence needs to be worked out.

Table 2: Burden of Various Cardiovascular Disorders in India as of 2005

| Disease | Total Population affected | Age Group <40 years affected (Young Burden) |
|---------------------------|----------------------------------|---|
| CAD (1) | 35.8 million | 13.4 million |
| HTN (6) | 200 million | * |
| DM(1) | 31.0 million | 6.4 million |
| CVA (15) | 1.2 million | 0.1 million |
| Obesity | * | |
| Metabolic syndrome | * | |
| RHD (15) | 0.7 million | Mostly involves young people |
| Total | 268.7 million | * |

* The exact prevalence needs to be worked out.

Rural and Urban Distribution of Various Cardiovascular Disorders in India

Various studies have revealed variable distribution of CVD in urban and rural areas.

Table 3: Urban and Rural Distribution of Cardiovascular Disorders in India

| Disease | Urban % | Rural % |
|-----------------|----------------|----------------|
| CAD (16) | 9.7. | 3.5 |
| HTN(17) | 24 | 17 |
| DM (8) | 15.5 | 3.77 |
| CVA | * | * |
| RHD(15) | 2.56 | 7.42 |

* The exact prevalence in rural and urban areas needs to be worked out.

Coronary Heart Disease

1) Prevalence of Coronary Heart Disease (CHD) in Indians

As evident from Table 4, within a short span of 5 years the number of

patients having CHD has increased by almost 10 million. This rising trend is observed both in urban as well as rural population. Total number of people suffering from CHD work out to be 35886789 . (Table 4 and Fig 1)

Table 4: Prevalence of CHD in India (1)

| Age (years) | 2000 | | | 2005 | | |
|-------------|---------|---------|---------|---------|---------|---------|
| | Rural | Urban | Total | Rural | Urban | Total |
| 20-29 | 1799691 | 2711501 | 4511192 | 2012363 | 413805 | 6150408 |
| 30-39 | 2854247 | 2635019 | 5489266 | 3383816 | 3869904 | 7253720 |
| 40-49 | 3342472 | 2776974 | 6119446 | 4127201 | 4116830 | 8334032 |
| 50-59 | 3590885 | 2288412 | 5879296 | 4544974 | 3171320 | 7716294 |
| 60-69 | 3153512 | 1888199 | 5041711 | 3849544 | 2582790 | 6432334 |

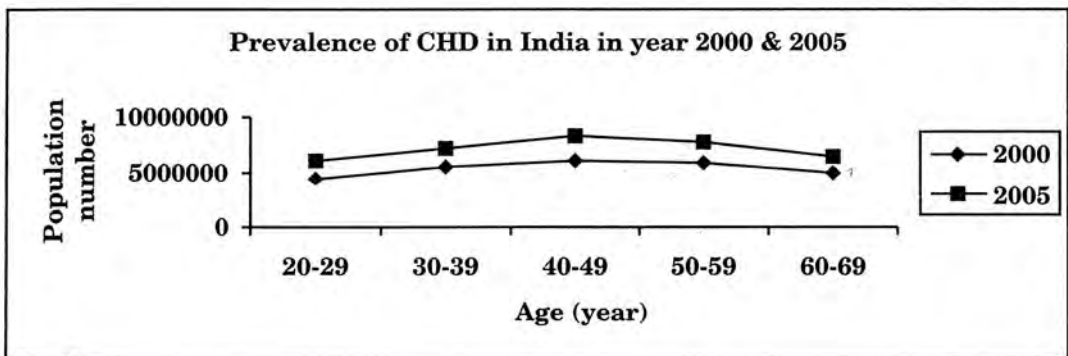


Fig 1: Graph based on National Health Profile 2006 (1)

As evident from Fig 1, the prevalence of CHD has increased among all the age groups in a span of 5 years.

2) Rural and Urban Distribution of Coronary Heart Disease (CHD)

The number of patients of CHD in rural population in India has increased from 1,47,40,808 to 1,80,07,899 whereas it has increased from

1,23,00,104 in to 1,78,78,889 in urban population within a period of 5 years (2000- 2005). (Table 4 and Fig 2). The increase in the number of subjects with coronary heart disease in the age group 35 -45 in rural population is a matter of concern from public health point of view.

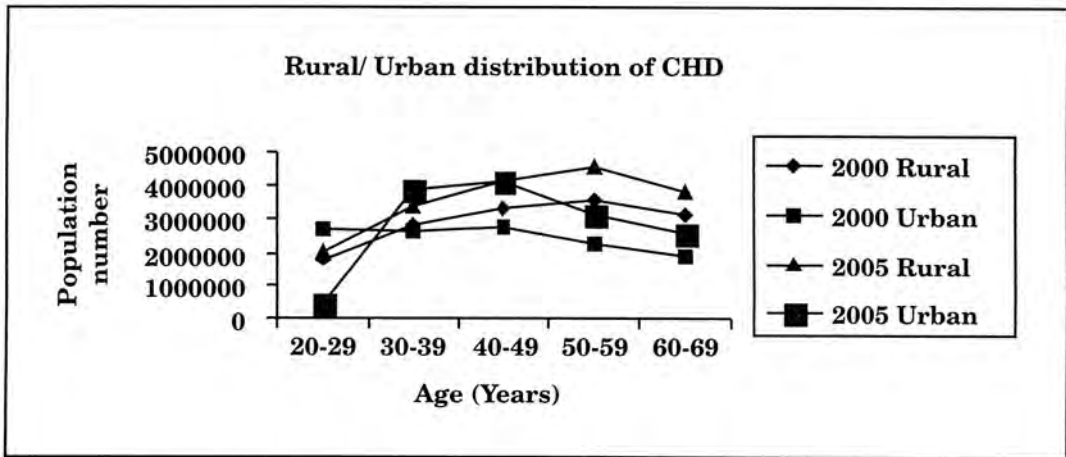


Fig 2: Graph showing rural and urban variation of CHD in India based on National Health Profile 2006 (1)

3) CAD in Young Adults

The problem of CAD in India is becoming alarming as the disease has started affecting the most productive age group people i.e. younger generation. The definition of young CAD has been varying from 35 to 45 years in different series. For the sake of working out economic impact of young CAD on society we have taken a cut off limit of = 40 years to label young

CAD (3). The prevalence of premature CAD in Indians is up to 3 times higher when compared with people of similar age group in the western world (22).

In West young CAD is about 5% and in India it is 12-16% in = 45 years. But, unlike in Whites, CAD in young Asian Indians is known to be severe, extensive, and malignant (23, 24). This is attributed to an accelerated atherosclerotic process that begins

early in life due to heredofamilial reasons (25).

4) CAD in Women

Despite the fact that the lifetime risk of death from CAD is more than 10 times greater than that from breast cancer, yet most of the women consider their risk of CAD to be 1% only (26). This lack of concern for CAD by women itself explains the vulnerability of this subgroup of population to the modern epidemic of CVD. The incidence of CAD increases with age in women, although the clinical presentation of the diseases lags 10 years behind that in men (26). Lifetime risk of developing CAD after the age of 40 years is 49% for men and only 32% for women, but women are more likely to experience significant morbidity and mortality associated with acute coronary syndrome (27). Typical angina has less predictive value

in females pretest probability is 50-60%, whereas it has 80-99% value in males (28). The young women are increasingly presenting with acute coronary syndromes. Though they enjoy certain degree of cardioprotection because of their hormonal effects, but this effect vanishes as they start smoking. And in case if early menopause superimposes on the deadly effect of smoking, the risk of premature CAD (Age =40 years) increases manifold. DM and or hypertension are considered to be the major culprit for premature CAD in women in absence of smoking (29, 30).

Type 2 Diabetes Mellitus

The global epidemic of T2 DM is progressively increasing in India and the toll has risen from 25 million cases in year 2000 to 31 million by the year 2005. (Table 5 and Fig. 3)

Table 5: Prevalence of Diabetes in India (1)

| Age (years) | 2000 | | | 2005 | | |
|--------------|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| | Rural | Urban | Total | Rural | Urban | Total |
| 20-29 | 549102 | 1003310 | 1552412 | 609128 | 1209725 | 1818853 |
| 30-39 | 1425108 | 2567970 | 3993077 | 1518041 | 3126311 | 4644352 |
| 40-49 | 2232090 | 3882005 | 6114095 | 2488845 | 4968478 | 7457323 |
| 50-59 | 2628455 | 4188171 | 6816626 | 2966586 | 5394860 | 8361446 |
| 60-69 | 2053095 | 2783100 | 4836195 | 2237319 | 3445602 | 5682920 |
| 70+ | 1100412 | 1401300 | 2501712 | 1267086 | 1807951 | 3075038 |
| Total | 9988262 | 15825855 | 25814117 | 11087005 | 19952927 | 31039932 |

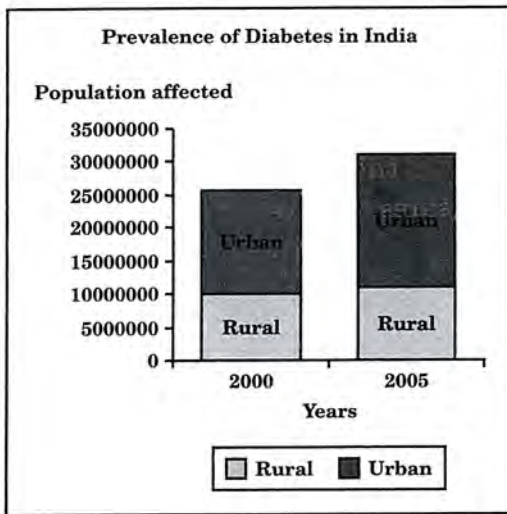


Fig 3: Graph based on National Health Profile 2006 (1)

Rheumatic Heart Disease

With improvement in overall socioeconomic status of society the prevalence of RHD is gradually declining over the years. So much so that the number of RHD cases in the last five years has remained almost same as evident from reports of National Commission on Macroeconomics and Health (15).

Estimated cases of RHD in 2000: 7, 64,556

Estimated cases of RHD in 2005: 7, 44,510

Stroke

Although we have pretty good information about the prevalence of CAD, T2 DM, HTN in the society; same is not true with stroke. It is only

recently that some data is available regarding stroke. The number of cases of stroke has marginally increased in the last five years from 1,081,480 to 1,247,812. (Table 6)

Table 6: Prevalence of Stroke in India (15)

| Age Group | Estimated cases in Year 2000 | Estimated cases in Year 2005 |
|--------------|------------------------------|------------------------------|
| 20-39 | 92746 | 104693 |
| 40-59 | 457365 | 534032 |
| 60-79 | 531369 | 609086 |
| Total | 1081480 | 1247812 |

Reasons for Increasing Prevalence of CVD

Most important causes of this phenomenal rise in CVDs are smoking, obesity, metabolic syndrome, increasing longevity and increase in total population itself. However, most worrying aspect is its progressively increasing premature occurrence in younger segment of the society in the last two decades.

Apparently there has been radical change in our lifestyle, dietary pattern and physical nature of job. Each of these conditions is linked to life style. Parallel to increase in obesity is the concurrent spurt of metabolic syndrome.

1) Smoking

Tobacco is the major cause of cardiovascular related deaths in the world today. Unfortunately India has the privilege of being the second largest producer of this killer. Nearly 5 million people die due to tobacco use every year and this figure will increase to 10 million tobacco attributable deaths per year by 2020 (34). In India alone it has been estimated that the number of people dying due to tobacco use every year are 8, 00,000 -9, 00,000 (35).

The consumption of smoking has been increasing at an alarming rate as a result of sophisticated global promotion strategies developed by multinational cigarette companies and local bidi industry.

Table 7: Prevalence of Smoking in India (15)

| Age group (years) | Males % | Females % |
|-------------------|---------|-----------|
| 15-19 | 4.4 | 0.2 |
| 20-24 | 13.7 | 0.6 |
| 25-29 | 25.1 | 1.1 |
| 30-39 | 37.6 | 2.2 |
| 40-49 | 45.0 | 4.0 |
| 50-59 | 45.3 | 5.7 |
| 60+ | 38.2 | 5.3 |
| Average | 29.4 | 2.5 |

Bidi being the cheaper option than cigarette is the most popular way of smoking among low socioeconomic group of people and in villages. Despite containing less tobacco than a cigarette, an unfiltered bidi releases two to three times more tar and nicotine, making them potentially more dangerous health hazard (36). And among their primary targets are the most vulnerable group namely woman and adolescent population who are ill equipped to cope with the slick marketing techniques and the dirty tricks perfected by the tobacco industry. It needs no over emphasis that chronic severe smoking ultimately leads to premature and accelerated atherosclerosis (37).

2) Obesity

Estimated prevalence of obesity in India is 26.5% based on body mass index criterion. This modern disease is rising unexpectedly at a rapid pace and is engulfing the vulnerable young population in developing countries like India (Table 8).

Currently more emphasis is being laid on measuring waist circumference which is a marker for central obesity. According to IDF standards the cut off points for waist circumference are 90 and 80 cms. for males and females respectively (12). One important factor for this is the rising life expectancy and

Table 8 : Prevalence of Obesity in India

Prevalence of obesity (11, 31, 32)

| | | |
|---|---------------------------|-------|
| Prevalence of obesity as per western cut off | BMI=30kg/m ² | 4% |
| | BMI=25.5kg/m ² | 9.9% |
| Prevalence of obesity as per Asia Pacific obesity criterion | BMI=25kg/m ² | 26.5% |
| Prevalence of obesity as per CURES study,2007 | BMI=23kg/m ² * | 45.9% |

* Time has come to consider this as a cut off as we are ethnically and phenotypically more susceptible for CAD and T2 DM.

the others are related to the rapid and chaotic urbanization with accompanying life style changes and to the powerful economic and cultural influences of globalisation. Junk food is replacing dietary fiber and the complex carbohydrates of fruits and vegetables. Junk foods are the foods that contain little or no proteins, vitamins or minerals but are rich in salt, sugar, fats and are high in energy (calories) (33). The Burgers of Mc Donald and the Pizzas are replacing healthy food in cities particularly in the metropolis. Calorie intake is multiplying whereas the physical activity is reducing. This mismatch between energy intake and energy output has manifested itself in a pandemic of obesity (2).

3) Metabolic Syndrome

The prevalence of central obesity, glucose intolerance, hypertension, high triglyceride (TG) levels, and low levels of high-density lipoprotein cholesterol (HDL-c) - the five 'axes of evil' of

metabolic syndrome is highest among the Indian community in south Asians. It continues to increase at a rapid pace (38, 39). In India the prevalence of metabolic syndrome has been estimated to be 23.2% by WHO criteria, 18.3% by ATP III criteria and 25.8% by IDF criteria (12).

Economic Burden of CVDs

Already reeling under the burden of poverty and illiteracy, the new burden of rising CVD in India has strained Indian economy to a great level. The big question is what the best option is: prevention or cure? An important warning sign about the road not to travel is now provided by the USA, the chief advocate of a technological approach to health. The American people are now grappling with a health care crisis without early solution in sight (2). Based on most conservative estimate the current cost of managing CAD cases would be as below (Table 9)

Table 9: Economic Burden of CAD #

| | Conservative Rx Polypill Approach for 1 year (18) | Coronary Angiography CAG (18) | Coronary Angioplasty PTCA (18) | Coronary Artery Bypass Graft CABG (18) | Ancillary Costs (Staff, Clinics, Hospitalisation) (18) | Life Style for 1 year |
|---------------------------|--|---|---|---|--|---|
| Cost Per patient | Rs 5500/- year (*) | Rs 5000/- event @ | Rs 1,00,000/- event | Rs 1,00,000/- event | — | Rs 7/- person/day ** |
| Cost for Total population | For 8 million patients Direct Cost: 44 billion For Ancillary medical services# #: 44 billion | For 1.27 million events/year 6.5 billion | For 30,000 events/year 3 billion | For 20,000 events/year 2 billion | — 100 billion | For 8 million patients/year 20.4 billion *** |
| Grand Total Cost per year | | | Rs 200 billion | | | Rs 20.4 billion |

We have used traditional costing method for calculating cost of medicines / polypill/ angiography / PTCA/ CABG.

@ Based on the assumption that each procedure costs Rs.5000

* Considering that total population affected from CAD in 2002 was 32 million out of which at any given time only 1/4th will be aware of their disease and will be on a minimum basic prescription following 'polypill approach' (Aspirin, beta blocker, ACE inhibitor and statin) (18, 40, 41). The average cost of generic form of these drugs in India is about Rs 15/day, that amounts to Rs 5500 per year.

** Based on the assumption that if a person stops smoking, the amount saved will be Rs 3/day/bundle of bidi and if the person consumes healthy food i.e. two fruits (Orange, Jamun,) and two vegetables (White-Gourd/Lockey, Ginger,), then the expenditure will be Rs 10 per day/per person; So that the net expenditure per day on adopting Life style measures will be Rs 10- Rs 3 =Rs 7/Day/person. (Table 10)

Ancillary medical services include cost of investigations and hospital visits.

*** Calculations are done on those 8 million patients who would have been protected from CHD if life style measures have been adopted timely but instead now require either conservative or invasive management.

The cost of treating CHD most conservatively in India is huge and amounts to the tune of Rs 200 billion whereas if early preventive measures are taken the cost will be reduced to a minimal of Rs 20.4 billion. The net saving of Rs 180 billion is enormous for our country. (Table 9)

Healthy life style measures include eating vegetables, fruits, increasing physical activity and stop smoking/tobacco use. The approximate cost per person is calculated in Table 10.

Table 10: Estimated Expenditure on Healthy Life Style

| Life Style Measure | Expenditure |
|---|-----------------------------------|
| Eating Two Vegetables/day (Lockey, Karela) | Rs 5/- day |
| Eating Two Fresh fruits (Orange, Jamun) | Rs 5/- day |
| Walking | Nil |
| Yoga | Nil |
| Stop Smoking | -Rs 3/- day * (Saving) |
| Total/person/day | Rs 7/- day |
| Total/person/year | Rs. 2555/- person/year |

* Presuming one bundle of bidi costs Rs 3.

The total cost for adopting healthy life style by a person will be Rs. 2555/ person/year.

Table 11 provides a comparison between the cost differences if various CVS disorders are treated instead of adopting preventive strategy. The estimated cost for treating various cardiovascular disorders is Rs 3178.1 billion whereas if simple lifestyle measures are adopted the cost shrinks to a mere Rs 615.7 billion. The net saving of Rs 2562.4 billion to the country is probably the evidence based answer for adopting preventive strategies at an early age.

Prevention

There is enough convincing data that simple life style measures lead to prevention of CAD in first stance and/or reversal of the atherosclerotic lesion (38, 44). Thus adopting prevention at an early age is an economical option than therapeutic interventions. As mentioned earlier the cost of treating various cardiovascular disorders would be Rs.3178.1 billion; India obviously cannot afford the mammoth expenditure of providing treatment to such a large number of diseases which are easily preventable. Moreover cardiovascular death strikes not as an unexpected bolt of lightning but as the culmination of a slowly evolving process marked by readily recognizable signposts. Pictorial signposts for individuals requiring preventive measures for CVS diseases are depicted below and graded as follows (Fig 4):

Table 11: Approximate Financial Burden of Various CVDs in India

| Disease | Total population affected | Population <40 years affected (Young Burden) | Total Economical burden/year for treatment of entire affected population (Rs billion) | Total Economical burden/year for treatment of <40 years age (Young Economical Burden) (Rs billion) | Total Economical burden/year if Life Style measures are adopted by entire affected population (Rs billion) | Net Saving if Life Style measures are adopted for prevention rather than treatment of CVDs (Rs billion) |
|----------------|---------------------------|---|---|---|--|---|
| CHD * | 35,886,789 | 13,404,128 | 200 | 74.7 | 20.4 | 179.6 |
| DM # | 31,039,932 | 6,463,205 | 618.12 | 128.5 | 79.3 | 538.9 |
| CVA ** | 1,247,812 | 104,693 (20-39yrs) | 1292 | 107.2 | 3.1 | 1288.9 |
| RHD *** | 744,510 | Not Applicable | 192 (tertiary prevention) | 192 (tertiary prevention) | 1.9 | 190.1 |
| HTN @ | 200 million | | 876 | **** | 511 | 365 |
| | | | Rs 3178.1 billion | **** | Rs 615.7 billion | Rs 2562.4 billion |

* Table 9 above

based on the assumption that the mean total annual cost direct (ambulatory plus hospitalization) as well as indirect is Rs. 19,914/person (7).

** Based on the assumption that cost of treating CVA in US is \$103 576/ person and in India the cost may be 1/4th of this cost i.e. \$25894/person i.e. Rs 1,035,760/ person (42).

*** Based on the costs of tertiary prevention of RHD in Pondicherry (43).

@ based on the assumption that a combination of diuretic and ACE inhibitor will cost approximately Rs 12/day to a patient.

**** The exact burden needs to be worked up.

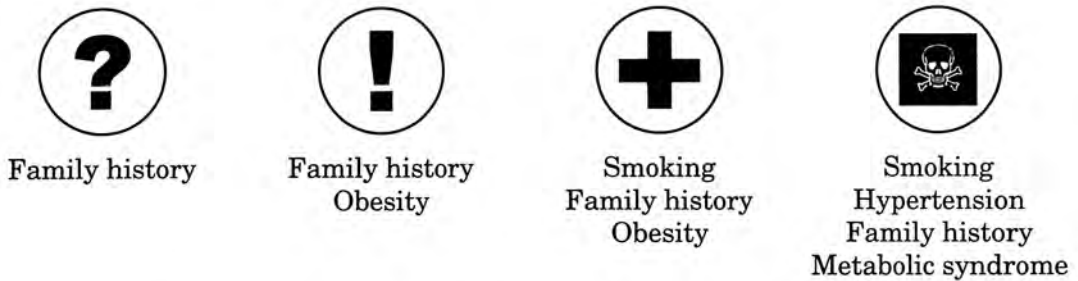


Fig 4: Pictorial signposts requiring preventive measures

Country shall be saving an estimated amount of Rs 2562.4 billion apart from uncalculated morbidity and mortality by adopting three simple steps namely (a) cessation of smoking, (b) start walking and (c) eating healthy food individually as well as at the community level.

Types of Prevention

Three types of prevention have been advocated by WHO:

Primordial Prevention

Primordial prevention was first suggested by Strasser in 1980, and it begins before the emergence of risk factors in a population. Inclination of healthy life style (No tobacco, Physical activity) has to be implemented at a very young age preferably in the entire population at primordial level to prevent 8 million potential cases. It

begins in early life, childhood and/ or adolescence when the health risk begins. Primordial prevention of CAD rests on the following core principles:

1. Prevention of maternal malnutrition.
2. Smoking cessation by mother during fetal life and subsequently by adolescent child.
3. Changes in dietary habits, healthy nutrition.
4. Regular non-occupational physical activity and increased occupational physical activity.
5. Control of mental stress – by yoga and stress management techniques.

As cardiovascular diseases are multifactorial there is a small possibility that even after adopting

healthy life style and polypill approach, some patients may still develop CAD, HTN, and or DM requiring secondary and tertiary care.

Primary Prevention

The preventive strategies aim at reversing the risk factors that have already established themselves in a population. It includes mass screening, health education and control of various risk factors. Prevention may be population based or targeting high-risk groups.

Primary Prevention in High Risk Individuals

1. Cessation of smoking.
2. 150 minutes of moderate physical activity such as brisk walking per week. It reduces the risk of developing T2 DM (8).
3. Dietary interventions: With the rapid urbanization and busy working schedules, the fast food culture has steadily crept in India. Young people get hardly any time for planning healthier meals and the burgers and pizzas provide an easily accessible alternative for their food. Such fast food frenzy is adding to the rapid increase in

burden of obesity. The best preventive step to curtail this is either to avoid eating at such outlets or at least eating healthy food at these outlets. Consuming a diet with less than 30% of energy as fat and less than 10% energy as saturated fat. It is also advisable to take wide range of carbohydrate foods rich in dietary fiber and of low glycemic index (cereals, vegetables, legumes and fruits).

4. Maintaining tight glycemic control has been shown to reduce risk of CHD in diabetics (8).
5. Systolic blood pressure reduction by 5 to 10 mm Hg results in 20-30% risk reduction in CHD events in diabetics (8).

Population Based Strategy for Prevention

This approach is based on the community participation and the government's will power to lower the risk factors in the whole population. And in developing countries like India with a huge population, a small change is likely to result in large benefits to the society as compared to large changes in a small number of high risk patients.

| STEP | Role of community | Role of government |
|------|--|---|
| 1 | People should eat healthy foods with adequate starch and fiber. | Make healthy foods like vegetables, fruits cheaper and easily available. |
| 2 | People should restrict eating junk food with high saturated fat. | Ban or restrict advertising of unhealthy food or allow them to advertise them with a word of caution. |
| 3 | Stop smoking | Smoking should be banned. Alternative to tobacco farming should be given financial support. |
| 4 | People should walk and exercise daily. | Government should ensure that there are open and safe spaces for sports and outdoor activities. |
| 5 | People should adopt lifestyle intervention programmes like yoga. | Yoga should be a part of regular training at schools and colleges. |

Secondary Prevention

Notwithstanding the role of antiplatelets, beta-blockers, ACE inhibitors and statins, the role of smoking cessation, healthy diet and physical activity maintains its utility in secondary program also.

1) Antiplatelet agents:

Aspirin: The antiplatelet trialists collaboration showed a 15% reduction in mortality due to vascular reasons and a 30% reduction in non-fatal events. Treatment with aspirin results

in significant reduction in restenosis following percutaneous coronary events (45).

2) Beta-blockers:

Beta blockers help by BP control as well as by other mechanisms. Beta-blockers offers benefits beyond blood pressure control especially by their anti ischemic, anti fibrillatory, anti thrombotic and anti atherosclerotic effects, regression of LVH, reduction in heart rate leading to prolongation of coronary diastolic filling.

3) ACE inhibitors:

The principal ACE-inhibitors are captopril, enalapril, ramipril, quinapril. Studies have shown that there is a dose dependent but blood pressure independent reduction in cardiovascular events with the use of ACE-inhibitors (45).

4) Statins:

They are now considered to be an integral part in the management of CVDs and have surpassed all the other classes of medicine in reducing the incidence of major adverse outcomes of death, heart attack and stroke (46).

Amongst various statins atorvastatin is considered to be the goal standard for prophylaxis of cardiac ischemia and stroke (46).

Conclusion

Reviewing the whole scenario of CVD and its health economics it can be safely concluded that a small investment in promoting healthy life style and dietary habits at primordial and primary level will reap larger economic and health benefits to the society run rather than spending colossal amount on curative medicine alone.

References:

1. National Health Profile 2006: www.cbhidghs.nic.in.
2. Lown B (2001). Cardiology at the crossroads: challenges for India and lessons from the west. *Indian Heart J* **53**:38-43.
3. Patel J, Dwivedi S, Lip GY, Hughes AE (2008). Premature coronary artery disease: An inferred CVS variant or south Asian genetic disorder? *Thrombosis & Hemostasis* **99**: 991-992.
4. Krishnaswami S (2002). Prevalence of coronary artery disease in India. *Indian Heart J* **54**:103.
5. Das SK, Sanyal K, Basu A (2005). Study of urban community survey in India: growing trend of high prevalence of hypertension in a developing country. *Int J Med Sci.* **2**: 70-78.
6. Mohan V, Deepa M, Farooq S, Datta M, Deepa R(2007). Prevalence, awareness and control of hypertension in Chennai—The Chennai Urban Rural Epidemiology Study (CURES-52). *J Assoc Physicians India* **55**:326-32.
7. Kapur A. Economic analysis of diabetes care (2007). *Indian J Med Res* **125**:473-482.

8. Gupta OP, Pathak S (2007). Alarming increase of diabetes mellitus and coronary heart disease in India. What are its causes and how can we contain it? *Ann Natl Acad Med Sci (India)* **43**:55-78.
9. Mohan V, Sandeep S, Deepa R., Shah B, Varghese C (2007). Epidemiology of type 2 diabetes: Indian scenario. *Indian J Med Res* **125**:217-230.
10. Dalal PM, Bhattacharjee M (2007). Stroke epidemic in India: hypertension- stroke programme is urgently needed. *JAPI* **55**:689-691.
11. Mohan V, Deepa M, Farooq S, Venkat Narayan KM, Datta M, Deepa R (2007). Anthropometric cut points for identification of cardiometabolic risk factors in urban Asian Indian population. *Metabolism* **56**:961-8.
12. Deepa M, Farooq S, Datta M, Deepa R, Mohan V (2007). Prevalence of metabolic syndrome using WHO, ATP III and IDF definitions in Asian Indians: the Chennai Urban Rural Epidemiology Study (CURES-34). *Diabetes Metab Res Rev.* **23**:127.
13. Shrivastava S (2007). Rheumatic Heart Disease: Is it declining in India? *Indian Heart J* **59**: 9-10.
14. Shet A, Kaplen E (2004). Addressing the burden of group A streptococcal disease in India. *Indian J Pediatr* **71**:41-8.
15. Burden of Disease in India: National Commission on Macroeconomics and Health Ministry of Health and Family Welfare, Government of India, New Delhi, September 2005.
16. Bahl VK, Prabhakaran D, Karthikeyan G (2001). Coronary artery disease in Indians. *Indian Heart J* **53**:707-13.
17. Mc Keigue PM, Fierie JE (1993). Association of early onset coronary heart disease in South Asian men with glucose intolerance and hyperinsulinemia. *Circulation* **87**:152-6.
18. Gupta R (2005). Burden of coronary heart disease in India. *Indian Heart J* **57**:632-38.
19. Yusuf S, Hawken S, Ounpuu S, Dans T, *et al* (2004). Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *Lancet* **364**:937-52.
20. Clark R (1999). Overseas postgraduate training- the challenge to the College. *Proc Royal College Physicians Edin* **29**:3-5.

21. Barnett A H, Dixon A N, Bellary S *et al* (2006). Type 2 diabetes and cardiovascular risk in the UK South Asian community. *Diabetologia* **49**:2234-46.
22. Lowry PJ, Lamb P, Watson RD, Ellis KE, Singh SP, Littler WA, *et al* (1991). Influence of racial origin on admission rates of patients with suspected myocardial infarction in Brimingham. *Br Heart J* **66**:29-35.
23. Sharma SN, Kaul U, Sharma S, Wasir HS, Manchanda SC, Bahl VK, Talwar KK, Rajani M, Bhatia ML (1990). Coronary arteriographic profile in young and old Indian patients with ischaemic heart disease: a comparative study. *Indian Heart J* **42** :365-9.
24. Pahlajani DB, Chawla MH, Kapashi KA (1989). Coronary artery disease pattern in the young. *J Assoc Physicians India* **37**:312-4.
25. Dwivedi S, Dwivedi G, Chaturvedi A, Sharma S (2000). Coronary artery disease in the young: heredofamilial or faulty life style or both. *J Ind Acad Clin Med* **3**:222-229.
26. American Heart Association. 2001 Heart and Stroke Statistical Update. American Heart Association, Dallas, 2001.
27. Wenger NK, Yusuf S (1998). Emerging epidemic of cardiovascular disease in developing countries. *Circulation* **97**:596-601.
28. Sullwan AK, Holdright DR, Wright CA, Sparrow JI, Cunningham D, Fox KM (1994). Chest pain in women: clinical, investigative and prognostic features. *BMJ* **308**:883-6.
29. Douglas PS, Ginsburg GS (1996). The evaluation of chest pain in women. *NEJM* **334**:1311-15.
30. Dhar M, Dwivedi S, Agarwal MP, Rajpal S, Vidholia A (2006). Clinical profile of coronary artery disease in women. *Indian J Cardiology* **9**:18-23.
31. Deepa M, Farooq S, Deepa R, Manjula D, Mohan V (2007). Prevalence and significance of generalized and central body obesity in an urban Asian Indian population in Chennai, India [CURES – 47]. *Eur J Clin Nutr* (In Press).
32. Misra A, Vikram NK, Gupta R, Pandey RM, Wasir JS, Gupta VP(2006). Waist circumference cutoff points and action levels for Asian Indians for identification of abdominal obesity. *Int J Obes (Lond)* **30**:106-11.

33. Rao VS, Subba Rao GM (2007). Eat Safe when eating out. *Nutrition* **38**:12-21.
34. World Health Organisation (WHO). Tobacco Free Initiative. Available from URL: <http://www.who.int/tobacco/en/>.
35. Reddy KS, Gupta PC (Eds). Report on Tobacco Control in India. Ministry of Health and Family Welfare, New Delhi, Government of India, 2004.
36. Negri E, Franzosi Mg, La Vecchia C, Santoro L, Nobili A, Togoni G (1993). Tar yield of cigarettes and risk of acute myocardial infarction. GISSI-EFRIM Investigators. *Brit Med J* **306**:1567-70.
37. Andrikopoulos GK, Richter DJ, Dilaveris PE, Pipilis A, Zaharoulis A, Gialafos JE, Toutouzas PK, Chimonas ET (2001). In hospital mortality of habitual cigarette smokers after acute myocardial infarction; the "smoker's paradox" in a countrywide study. *Eur Heart J* **22**:776-84.
38. Deedwania P, Singh V (2005). Coronary artery disease in south Asians: evolving strategies for treatment and prevention. *Indian Heart J* **57**:617-631.
39. Bhopal R, Hayes L, White M, Unwin N, Harland J, Ayis S, et al (2002). Ethnic and socioeconomic inequalities in coronary heart disease, diabetes and risk factors in Europeans and South Asians. *J Public Health Med* **24**:95-105.
40. Yusuf S (2002). Two decades of progress in prevailing vascular disease. *Lancet* **360**:2-3.
41. Wald NJ, Law MR (2003). A strategy to reduce cardiovascular disease by more than 80%. *BMJ* **326**:1419-1423.
42. Taylor TN, Davis PH, Torner JC, Holmes J, Meyer JW, Jacobson MF (1996). Lifetime cost of stroke in the United States. *Stroke* **27**:1459-1466.
43. Soudassanane MB, Karthigeyan M, Mahalakshmy T, Sahai A, Srinivasan S, Rao KSVK, Balachander J (2007). Rheumatic fever and rheumatic heart disease: Primary prevention is the cost effective option. *Indian J of Pediatrics* **74**:567-570.
44. Selvan MS, Kurpad AV (2004). Primary prevention: why focus on children and young adolescents? *Indian J Med Res* **120**:511-518.
45. Eagle K (2008). Coronary artery disease in India: challenges and opportunities. *Lancet* **37**:11394-95.
46. Topol EJ (2004). Intensive statin therapy- a sea change in cardiovascular prevention. *N Engl J Med* **350**:1-3.