

# **National Cardiovascular Disease Database**

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**IC HEALTH**

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## **Introduction**

According to World Health Report 2002, cardiovascular diseases (CVDs) will be the largest cause of death and disability by 2020 in India. In 2020 AD, 2.6 million Indians are predicted to die due to coronary heart disease which constitutes 54.1 % of all CVD deaths. Nearly half of these deaths are likely to occur in young and middle aged individuals (30-69 years). Currently Indians experience CVD deaths at least a decade earlier than their counterparts in countries with established market economies (EME). The Global Burden of Disease (GBD) study estimates that 52% of CVD deaths occur below the age of 70 years in India as compared to 23% in EME, resulting in a profound adverse impact on its economy. The contributing factors for the growing burden of CVDs are increasing prevalence of cardiovascular risk factors especially hypertension, dyslipidemia, diabetes, overweight or obesity, physical inactivity and tobacco use. It is an area where major health gains can be made through the implementation of primary care interventions and basic public health measures targeting diet, lifestyles and the environment.

In order to formulate national policies for the prevention and control of CVDs, we require nationally representative data collected through standardized techniques. Although studies have been conducted to assess CVD and its risk factor burden in many regions of India, the data was not compiled together. Understanding this problem, we tried to establish a database of all the studies and projects in past and present, relating to CVD epidemiology and prevention in India. This compilation would serve as an exhaustive database on relevant information about CVD in India and as a guide for future policy

and research. It will be made accessible to all major stakeholders. In this report we have included prevalence data on

- Coronary heart disease,
- Diabetes mellitus,
- stroke and risk factors like
- High blood pressure,
- Hypercholesterolemia,
- Metabolic syndrome,
- Hyper LDL-cholesterolemia,
- Hypertriglyceridemia,
- Low HDL-cholesterolemia,
- Smoking,
- Physical activity and
- Overweight/Obesity based on high-BMI, high Waist-hip ratio and high Waist circumference.

In addition, Mean values of anthropometric measurements and biochemical parameters listed in various studies are also summarized.

### **Prevalence of Coronary Heart Disease (CHD) in Indian population**

Estimates on prevalence of coronary artery disease obtained from cross sectional surveys are summarised here. For comparison, age and sex-specific standardized rates are provided wherever available. We searched the MEDLINE, EMBASE and INDMED databases from 1950-2005, to obtain prevalence studies on Coronary Heart diseases. The search terms used were “prevalence”, “coronary heart disease”, “myocardial

infarction”, “angina”, “heart” and “India”. This was supplemented by examining the reference lists of each of the articles identified (both primary and review articles), manual retrieval, consulting with experts in the subjects, and checking citations. Most studies deal with information on prevalence and vary in time period of data collection, location, definition used etc. Studies carried out after 1970 will be meaningful for any comparison as the Minnesota code was published in 1969.

### **Characteristics of identified studies**

Using the above search techniques, we identified twenty-one epidemiological studies published between 1950 and 2005. To qualify for inclusion the study had to have a sample size (>150) and a reported CHD prevalence using defined criteria. For multiple publications, from a single study, we chose the study with highest sample size unless other articles dealt with special issues. All the studies identified were cross sectional in nature.

Criteria for diagnosis of CHD included response to Rose Angina Questionnaire, ECG criteria (Using Minnesota codes) and clinical history. Few studies have published individual prevalence as well as combination of the above criteria's. In case of multiple prevalence, all the data based on multiple prevalence's were included.

Table 1 (*Refer Table 1-2 (CHD).xls*) display the study location (urban vs. rural), period of data collection, age and sex-stratified prevalence, prevalence of CHD in the total group, men and women separately, sample size, criteria for diagnosis, study setting and reference of all selected studies. The studies are arranged in a chronological order. If the study period is not mentioned in the article, the publication date is adopted for arranging the data.

### **Prevalence of CHD**

Dewan BD<sup>16</sup> published the first Indian study using the Minnesota code in 1974, which reported CHD prevalence of 2.28 % among males and 1.73% among females in rural Maharashtra. Later during 1987-88 Chadha et al<sup>11</sup> carried out a study in the rural areas of Haryana and reported a lower prevalence of symptomatic CHD among men (0.74%) and women (0.51%) while total prevalence was higher (2.71%) when silent CHD cases

were also included. The urban sample had a higher symptomatic CHD prevalence (3.19%) compared to rural areas (0.59%).

ICMR Task force study<sup>43</sup> carried out in 1991-94 reported 11% and 10% prevalence of CHD among men and women respectively in urban Delhi. At the same time the rural areas in Haryana had a lower prevalence (5.6% & 6.4%) than urban Delhi. Gupta R<sup>36,29</sup> carried out serial epidemiological surveys in Jaipur during 1992-95 and 2001 and presented almost similar prevalences among men (5.96% vs 6.18%) and women (10.5% vs 10.1%). Although no major differences in total prevalence was reported, age specific rates show a decline in males less than 40 years old. There was an increase in CHD prevalence in those aged 40–59 years among men.

South Indian population in general had higher prevalence compared to north Indian population. Ramchandran A<sup>105</sup> reported 4% CHD prevalence in Chennai during 1994 while Mohan V<sup>61</sup> documented a higher prevalence (11%) during 1996-97. Similarly, Kutty VR<sup>51</sup> carried out a study in the rural areas of Kerala and found 7.4 % prevalence of CHD among twenty-five plus age group during 1990-91. Beegom R<sup>7</sup> reported 13.9% of CHD prevalence in 1995 in the urban areas of Trivandrum, Kerala.

## **Incidence of Coronary Heart Diseases in Indian population**

Through the systematic literature search, we could locate three incidence studies on CHD in Indian population. The three incidence studies used different methods to attain data and so are not directly comparable. Chadha et al<sup>121</sup> carried out a prospective cohort study while Gupta and Khetrapaul<sup>120</sup> carried out a registry based study. The earliest study was carried out by Gupta et al<sup>120</sup> during 1977-78 reported the incidence of CHD among men and women at 0.57% and 0.23% each. Trivedi et al<sup>121</sup> followed a cohort in Kheda, Gujrat from 1987 to 1992 and demonstrated the incidence of CHD at 0.252%. Chadha et al<sup>122</sup> conducted two repeat surveys in Delhi and documented the incidence of CHD, during 3 year period after initial survey carried out during 1987-90, at 1.73% among men and 2.1% among women. The Details are shown in Table no 2 (*Refer Table 1-2 (CHD).xls*).

## **Prevalence of Hypertension in Indian population**

### **Methodology of Search**

We searched the MEDLINE, EMBASE and INDMED databases from 1940-2005, to obtain prevalence studies on hypertension in Indian population. The search terms used were “prevalence”, “hypertension”, “high blood pressure”, “coronary risk factors”, and “India”.

### **Characteristics of identified articles**

Using the above literature search techniques, we identified fifty-two epidemiological studies published between 1940 and 2005. All the studies identified were cross sectional in nature. Table-3 shows the study location (urban vs rural), age group studied, sample size, criteria for diagnosis of hypertension, prevalence of hypertension in the total group, men and women separately. There were marked heterogeneity among studies mostly due to the varying time periods of data collection and differing definitions of hypertension. However, prevalence of hypertension based on JNC V criteria was available from 22 studies across India.

### **Prevalence of Hypertension**

Dubey VD<sup>18</sup> carried out one of the earliest study in India (1954), documented 4% prevalence of hypertension (criteria: >160/95) amongst industrial workers of Kanpur. In 1984, Wasir HS et al<sup>101</sup> reported 3% prevalence of hypertension (criteria:  $\geq$  160/95) in Delhi. During 1984-87 Gopinath and Chadha et al<sup>11,22</sup> reported the prevalence of hypertension in Delhi (criteria:  $\geq$ 160/90) to be 11% among males and 12% among females in the urban areas and 4% and 3% respectively in rural areas. Another two studies carried out in rural areas of Haryana<sup>54</sup> (1994-95) demonstrated 4.5% prevalence of hypertension (JNC V criteria) while urban areas of Delhi had a higher prevalence of 45% during 1996-97<sup>2</sup>.

In the ICMR study<sup>43</sup> in 1994 involving 5537 individuals (3050 urban residents and 2487 rural residents) demonstrated 25% and 29% prevalence of hypertension (Criteria:

$\geq 140/90$  mm of Hg) among males and females respectively in urban Delhi and 13% and 10% in rural Haryana.

Further, Gupta R from Jaipur, through three serial epidemiological studies (Criteria:  $\geq 140/90$  mm of Hg) carried out during 1994<sup>36</sup>, 2001<sup>29</sup> and 2003<sup>37</sup> demonstrated rising prevalence of hypertension (30%, 36%, and 51% respectively among males and 34%, 38% and 51% among females).

From south India, Kutty VR<sup>51</sup> carried out hypertension prevalence study (criteria:  $\geq 160/95$  mm of Hg) in rural Kerala during 1991 in the 20 plus age group and the prevalence was found to be 18%. Later studies in Kerala (Criteria: JNC VI) reported 37% prevalence of hypertension among 30-64 age group<sup>52</sup> in 1998 and 55% among 40-60 age group<sup>103</sup> during 2000. A higher prevalence of 69% and 55% was recorded among elderly populations aged sixty and above in the urban and rural areas respectively during 2000<sup>42</sup>.

Few studies on prevalence on hypertension are available from eastern Indian population. In 2002, Hazarika et al<sup>41</sup> reported 61% prevalence (criteria: =JNC VI) among man and women aged thirty and above in Assam.

The Sentinel Surveillance Project<sup>102</sup>, documented 28% overall prevalence of hypertension (criteria: =JNC VI) from 10 regions of the country in the age group 20-69. Another study<sup>123</sup> carried out in 1998 among Industrial population in the Bharat Electronics Limited (BEL), India using the same criteria illustrated a prevalence of 30% among men.

Few studies were carried out comparing different socio economic groups. The initial study from urban Chennai, Mohan et al<sup>62</sup> reported 8.4% prevalence of hypertension among men and women aged 20 years and above and belonging to the low socio economic group (based on household income, occupation and dietary pattern). Similarly, in the middle socio economic group had a higher prevalence (15%) during



1996-97. A study conducted in the urban areas of Chennai during 2000<sup>73</sup> (age group  $\geq 40$ ) reported a higher prevalence of hypertension (54%) among low income group (monthly income  $<$  Rs 30000/annum and 40% prevalence among high-income group (monthly income  $\geq$  Rs 60000/annum). Misra et al<sup>58</sup> reported 12% prevalence of hypertension in the slums of Delhi. The details are summarized in Table no 3 and 4. *(Refer Table 3-4 (Blood pressure).xls)*

# Diabetes and Blood glucose levels in Indian Population

## Methodology of Search

Prevalence studies on Diabetes were identified as using the same methodology described previously. The search terms used were “prevalence”, “diabetes” “hypertension”, “coronary risk factors”, “glucose abnormalities”, “dysglycaemia”, “coronary”, “insulin and metabolic syndrome” and “India”.

## Characteristics of identified articles

Using the above literature search techniques, we identified twenty-seven epidemiological studies published between 1950 and 2005. All the studies identified were cross sectional in nature. Table 5 shows the study location (urban Vs rural), age group studied, sample size, criteria for diagnosis of diabetes, prevalence of diabetes in the total group, men and women separately. There were marked heterogeneity among studies mostly due to the varying time periods of data collection and differing definitions of diabetes.

During 1972-75, ICMR<sup>3</sup> carried out a large multicentric study in India, which documented 2.6% and 1.5% prevalence of diabetes (criteria: FBS>5.6mmol/l or Post 1-h glucose value>=7.8mmol/l or Post 2-h glucose value>=6.7mmol/l) among men and women in the urban areas while in rural areas had a lower prevalence: 1.8% and 1.3% respectively. Later, Gopinath and Chadha et al<sup>11,22</sup> reported the prevalence of diabetes (criteria: clinical history and documented evidence of medication) to be 1.6 % among males and 1.6% among females in the urban areas and 0.5% and 0% respectively in rural areas in Delhi during 1984-87. In 1994, ICMR Task force carried out a study involving more than 5000 individuals (3050 urban residents and 2487 rural residents) as part of the ICMR task force project,<sup>43</sup> which demonstrated 14% prevalence of diabetes (criteria: FBS>126mg% or history) urban Delhi and 3% in rural Haryana.

In 1994, Wander GS reported 5% prevalence of diabetes (criteria: random venous blood glucose >180mg/dl or history) among a rural population in Ludhiana, Punjab<sup>100</sup>. Further, Gupta R from Jaipur, through three epidemiological studies carried out during 1994<sup>36</sup>, 2001<sup>29</sup> and 2003<sup>37</sup> demonstrated rising trend rates of diabetes (criteria: FBS>126mg/dl or history) 1%, 13%, and 18% respectively among males and 1%, 11% and 14% respectively among females.

Similar trends were observed in other parts of the country. Ramachandran A<sup>69</sup> reported a prevalence of 8.2% during 1989 in urban Chennai. Subsequent studies from urban Chennai reported the prevalence of diabetes at 11.6% in the year 1995<sup>71</sup> and 14% during 2000<sup>70</sup> (2-h post glucose value  $\geq$ 200mg/dl). Prevalence of diabetes (criteria: 2-h post glucose $\geq$ 11.1 mmol/l) in the rural areas of Tamil Nadu rose sharply from 2.4% in 1989 to 6% in 2003<sup>74</sup>.

Kutty VR<sup>53</sup> carried out a study in Kerala during 1998-99 using the WHO criteria and the prevalence of diabetes was found to be 5.9%. Joseph et al<sup>47</sup> reported 16% prevalence in the urban areas of Trivandrum in Kerala.

In 2000, a multi centric study<sup>70</sup> involving six urban cities in India (Chennai, Bangalore, Hyderabad, Mumbai, Calcutta and New Delhi) in the country among the age group of 20 and above showed a prevalence of 14% among men and women (sample size: 5288 men; 5928 women).

The Sentinel Surveillance Project<sup>102</sup>, documented 10% overall prevalence of diabetes from 10 regions of the country using the criteria (FPG  $\geq$  126 mg/dl or on treatment) in the age group 20-69. Details of the prevalence studies and mean blood glucose levels in Indian population are summarized in Table no 5 and 6. (*Refer Table 5-6 (Diabetes).xls*)

## Metabolic syndrome in Indian Population

The earliest study<sup>43</sup> on prevalence of Metabolic Syndrome in India was done in the urban areas of Delhi and rural Haryana and the prevalence was 30% and 11% respectively during 1992-94 (criteria: ATP III). Later, Ramachandran et al<sup>72</sup> (modified ATP III criteria) documented a higher prevalence of metabolic syndrome (41%) in 1995 and Deepa et al<sup>124</sup> reported 11.2% prevalence (criteria: European group for study of insulin resistance-HOMA model) in urban Chennai during 1996-97. Gupta et al<sup>125</sup> reported 25% prevalence (ATP III criteria) in Jaipur. The Sentinel surveillance project<sup>102</sup> in Indian Industrial population illustrated 27% prevalence (ATP III criteria) during 2001-03. Misra et al<sup>58</sup> carried out a study among the urban slum population in Delhi, reported 30% prevalence (own criteria) of metabolic syndrome. The details of the studies are given Table no 7. (*Refer Table 7 (Met-syndrome).xls*)

## **Prevalence of Overweight/Obesity in Indian population based on Body Mass Index (BMI)**

We searched the MEDLINE, EMBASE and INDMED databases from 1950-2005, to obtain prevalence studies of overweight & obesity. The search terms used were “prevalence”, “overweight”, “obesity”, “body mass index”, “hypertension”, “high blood pressure”, “glucose abnormalities”, “dysglycaemia”, “coronary”, “diabetes” “insulin and metabolic syndrome” and “India”. This was supplemented by examining the reference lists of each of the articles identified (both primary and review articles), manual retrieval, consulting with experts in the subjects, and checking citations.

### **Characteristics of identified articles**

Using the above search techniques, we identified thirty-two epidemiological studies published between 1950 and 2005. To qualify for inclusion the study had to have a sample size (>150) and a reported overweight/obesity prevalence using defined criteria. For multiple publications, from a single study, we chose the study with highest sample size.

All the studies identified were cross sectional in nature. Of the thirty-two studies eleven studies address special issues like obesity among adolescents (five studies), urban-rural differences (three studies), socio economic differences (three studies) and slum vs. non-slum differences (two studies). Three studies were multi centric in nature.

Table 8 shows the study location (urban vs rural), age group studied, sample size, criteria for diagnosis of overweight/obesity, prevalence of overweight/obesity in the overall group, men and women separately.

Most studies mentioned the prevalence of overweight/obesity as ancillary information and hence age-wise distribution of prevalence was lacking. There were marked heterogeneity among studies mostly due to the varying time periods of data

collection and differing definitions of obesity. However, prevalence of overweight/obesity based on NHANES III criteria was available from 16 studies across India.

### **Prevalence of Overweight/Obesity**

One of The earliest study was carried out by Gopinath and Chadha et al<sup>11,22</sup> in Delhi during 1984-87. They reported 27% prevalence of overweight/obesity in the urban areas and 10% in rural areas. In 1994, ICMR task force<sup>43</sup> carried out a study involving more than 5000 individuals (3050 urban residents and 2487 rural residents) demonstrated 43% prevalence of overweight in urban Delhi and 12% in rural Haryana.

Two other studies from north India published during 1994 and 2000 showed a prevalence of 17% (Ludhiana)<sup>100</sup> and 15 % (Kashmir)<sup>104</sup> respectively. Further, Gupta R from Jaipur, through three epidemiological studies carried out during 1994<sup>36</sup>, 2001<sup>29</sup> and 2003<sup>37</sup> demonstrated rising trend rates of 20%, 36%, and 62% respectively.

Similar trends are observed in other parts of the country. The earliest study from the south Indian population reported a prevalence of 27% during 1989<sup>69</sup> in urban Chennai and 2% in rural Tamil Nadu. Subsequent studies from urban Chennai reported the prevalence of overweight/obesity at 23% in the year 1995<sup>71</sup> and 30% during 2000<sup>70</sup>. Prevalence in the rural areas of Tamil Nadu rose sharply from 2% in 1989 to 17% in 2003<sup>74</sup>. Kutty VR<sup>51</sup> carried out a study in rural Kerala during 1991 using the criteria (BMI>27) and the prevalence was found to be 5.8%. Later studies in Kerala reported 49% prevalence of overweight among 30-64 age group<sup>52</sup> in 1998 and 41% among 40-60 age group<sup>103</sup> during 2000. A higher prevalence of 54% (criteria: BMI>22.25) was recorded among elderly populations (age group: >=60) during 2000<sup>42</sup>.

The "Sentinel Surveillance Systems for CVD in Indian Industrial Populations"<sup>102</sup>, involving ten centres from different parts of the country (survey period 2001-2003). The population studied included industrial employees and their family members aged 10-69 years. Overall prevalence of overweight/obesity from 10 regions of the country using the criteria (BMI>=25) in the age group 20-69 was 31%. Dibrugarh in Assam had the

lowest prevalence (0.5%) while Hyderabad in Andhra Pradesh had the highest (50%). North Indian populations in Delhi, Lucknow in Uttar Pradesh and Ludhiana in Punjab had prevalences of 41%, 37% and 15% respectively. Central Indian populations in Nagpur and Pune in Maharashtra had prevalences of 20% and 36% respectively. South Indian populations from Bangalore in Karnataka, Trivandrum in Kerala and Coimbatore in Tamil Nadu had a prevalence of 47%, 38% and 27% respectively. Another study<sup>123</sup> carried out in 1998 among Industrial population in the Bharat Electronics Limited (BEL), Delhi, India illustrated a prevalence of 35% among males. The prevalence of overweight/obesity had risen from 35% to 41% over a period of five years in BEL,

The urban cities in the country are facing high prevalence of obesity. In 2000, a multi centric study<sup>126</sup> involving seven urban cities (Chennai, Bangalore, Hyderabad, Mumbai, Calcutta and New Delhi) in India among the age group of 20-40 and  $\geq 40$  age group showed a prevalence of 31% and 38% respectively (sample size: 5288 men; 5928 women). Similarly, Shukla et al<sup>85</sup> conducted a large study in Mumbai, Maharashtra during 1994 and reported a prevalence of 26% among above 35 age group.

Few studies were carried out comparing different socio economic groups. In urban Chennai, Mohan et al<sup>62</sup> reported 20% prevalence of overweight/obesity among men and women aged 20 years and above and belonging to the low socio economic group (based on household income, occupation and dietary pattern) while, the middle socio economic group had a higher prevalence (35%) during 1996-97. A study conducted in the urban areas of Chennai during 2000<sup>73</sup> (age group  $\geq 40$ ) reported a higher prevalence of 33% among low income group (monthly income < Rs 30000/annum and 44% prevalence among high-income group (monthly income  $\geq$  Rs 60000/annum).

Some studies addressed the gradients of obesity among slum /non-slum groups. ICMR Task force study<sup>43</sup> among dwellers of urban slum in Delhi showed a prevalence of 20%, as compared to urban and rural prevalence of 48% and 12% respectively. Misra et al<sup>59</sup> reported 25% prevalence of obesity in the slums of Delhi.

Prevalence of overweight/obesity among adolescents and young adults had been reported from Delhi, Pune, Kerala and Tamil Nadu. Prevalence was higher among adolescent from Tamil Nadu (BMI $\geq$ 25) even though the studies from Delhi study used a lower criteria (BMI $\geq$ 23). Prevalence in Delhi<sup>60</sup> was 18 % while in Tamil Nadu<sup>127</sup> it was 20%. Khadilkar et al<sup>128</sup> reported a prevalence of 26% (BMI $>$ 25) among affluent school boys aged between ten and fifteen in Pune while Augustine et al<sup>129</sup> reported 24% prevalence of overweight/obesity (BMI $>$ 23) among urban college going girls aged between seventeen and eighteen in Ernakulam, Kerala. The details of the prevalence studies are given in Table no 8 and mean BMI values are summarized in Table no-9. *(Refer Table 8-9 (BMI).xls)*



# **Prevalence of Abdominal obesity in Indian population based on high Waist Circumference (WC)**

## **Methodology of Search**

Prevalence studies on Abdominal Obesity were identified as using the same methodology described previously. The search terms used were “prevalence”, “overweight”, “obesity”, “waist circumference”, “coronary”, “hypertension”, “high blood pressure”, “glucose abnormalities”, “dysglycaemia”, “diabetes”, “insulin and metabolic syndrome” and “India”.

## **Characteristics of identified articles**

Using the above literature search techniques, we identified seven epidemiological studies published between 1950 and 2005. All the studies identified were cross sectional in nature. Of the seven studies two were multi-centric, two studies address the issue of obesity among adolescents, one study compared slum vs. non-slum differences and two studies were conducted among industrial population.

Table 10 shows the study location (urban vs rural), age group studied, sample size, criteria for diagnosis of abdominal obesity, prevalence of abdominal obesity in the total group, men and women separately. Mean waist circumference levels are summarized in Table no 11. (*Refer Table 10-11 (Waist Circumference).xls*)

## **Prevalence**

Similar to data on BMI, most studies provided the prevalence of abdominal obesity as ancillary information and hence age-wise distribution of prevalence was lacking. There were marked heterogeneity among studies mostly due to the varying time periods of data collection and differing definitions of abdominal obesity. Prevalence of abdominal obesity based on Adult Treatment Protocol III was available with three studies and two studies used the modified ATP III recommendations for Indian population as their criteria. Remaining studies greatly varied in their definition for abdominal obesity.

Studies were mostly carried out among north Indian populations. Gupta et al reported a prevalence of abdominal obesity in Rajasthan from 33.2% during 2001<sup>29</sup> to 45% during 2003<sup>37</sup> among adults using the ATP III criteria (WC: Males->102cm, Females->88 cm). ICMR Task force Project study<sup>43</sup> (1994) reported a higher prevalence in urban Delhi (31%) and a lower prevalence in rural Haryana (8%) using the criteria (WC: >94cm among men and >88 cm among women). The urban slum group in the above study had a prevalence of 12%. Misra et al<sup>59</sup> reported a prevalence of 17% among adults belonging to lower socio economic groups in Delhi using ATP III criteria.

A study from Chennai reported a high prevalence of abdominal obesity among adults during 1995<sup>72</sup> (31%) using modified ATP III criteria (WC: >=90cm among men and >=85 cm among women).

The Sentinel surveillance on CVD in Indian industrial population<sup>102</sup> (2001-03), using modified ATP III criteria for Asians (WC: >90cm among men and >85 cm among women) reported an overall prevalence of abdominal obesity at 32%. Dibrugarh in Assam had the lowest prevalence (0.7%) while Hyderabad in Andhra Pradesh had the highest (52%). North Indian population in Delhi, Lucknow in Uttar Pradesh and Ludhiana in Punjab had a prevalence of 42%, 34% and 17% respectively. Central Indian populations in Nagpur and Pune in Maharashtra had a prevalence of 24% and 34% each. South Indian populations from Bangalore in Karnataka, Trivandrum in Kerala and Coimbatore in Tamil Nadu had a prevalence of 45%, 32% and 41% respectively. Another study<sup>123</sup> among Industrial population in the Bharat Electronics Limited, Delhi showed a prevalence of 43% among males.

Among adolescents and young adults in Delhi, Misra et al<sup>60</sup> and Vikram et al<sup>98</sup> reported a prevalence of 17% (age group 14-18) and 14% (age group 14-25) using the criteria of WC >79cm among males and >76 cm among females.

## **Prevalence of overweight/obesity based on high Waist Hip ratio (WHR)**

### **Methodology of Search**

Prevalence studies on high waist hip ratio were identified as using the same methodology described previously. The search terms used were “prevalence”, “overweight”, “obesity”, “waist-hip ratio”, “coronary”, “hypertension”, “high blood pressure”, “glucose abnormalities”, “dysglycaemia”, “diabetes”, “insulin and metabolic syndrome” and “India”.

### **Characteristics of identified articles**

Using the above literature search techniques described earlier, we identified eleven epidemiological studies published between 1993 and 2005. All the studies identified were cross sectional in nature. Of the eleven studies, one study was multi-centric and another one addressed the issue of obesity among adolescents. Comparison of obesity among different socio economic, urban-rural differences and slum vs. non-slum differences were available with one study each.

Various definitions were used in these studies to define overweight/obesity. In these studies the most common definition used was of WHR among males  $>0.9$  and females  $>0.8$ . Other definitions used were males  $>0.95$ , females  $>0.8$ ; males  $>0.86$ , females  $>0.84$ ; males  $\geq 0.87$ , females  $\geq 0.85$  and males  $>0.9$ , females  $>0.85$ . These studies were predominantly done in urban areas. Table 12 and 13 shows data on prevalence of high WHR and mean WHR respectively with data on study location (urban vs rural), age group studied, sample size, criteria for diagnosis of high waist-hip ratio, prevalence of high WHR in the total group, men and women separately. (Refer Table 12-13 (WHR).xls)

## **Prevalence:**

The ICMR Task force project<sup>43</sup> reported 65% prevalence of high waist hip ratio in urban Delhi and 52% in rural Haryana in 1994 using the criteria (WHR: M->0.9, F->0.8). Serial epidemiological surveys in urban Rajasthan had shown the prevalence at 60% during 1994<sup>36</sup>, 63% during 2001<sup>29</sup> and 79% during 2003<sup>37</sup> using the criteria (WHR: male->0.9, female->0.8). During 1993<sup>28</sup>, rural Rajasthan had a prevalence of 21% (WHR: male->0.93). In 2002, Reddy NK<sup>77</sup> reported 74% prevalence of high waist hip ratio among workers of a political party in Andhra Pradesh.

Vikram et al<sup>99</sup> reported 34 % (WHR: male->0.95, female->0.8) prevalence among urban slum dwellers in Delhi during 2000. In Chennai, Mohan et al<sup>62</sup> demonstrated the prevalence of high waist hip ratio (criteria: WHR: M->0.9, F->0.85) higher among middle income groups (29%) compared to low income group (23%). It also showed the prevalence of overweight-obesity to be almost twice among males compared to females in low-income groups whereas in middle-income groups it was almost the same among males and females.

Studies among industrial population (Bharat Electronics Limited, Delhi) shows a very high prevalence (67%) of high waist hip ratio (criteria: WHR: male->0.95)<sup>123</sup>. Recent studies done in Delhi<sup>60</sup> during 2002, among adolescents show a high rate of overweight-obesity (19%) using the criteria (WHR: male->=0.87, female->=0.85).

## Prevalence of Dyslipidaemia in Indian population

High serum lipid levels are major risk factors of coronary heart diseases that are influenced by lifestyle transition and urbanization. Limited information exists regarding the changing time-trends in lipid levels and the prevalence of dyslipidaemia in Indian subjects. In 1961 Padmavati et al<sup>63</sup> reported mean levels of total cholesterol levels across different socio economic groups in Delhi. Later Chadha et al<sup>11</sup> Reported 44% prevalence of hypercholesterolemia among men and 50% prevalence among women in urban Delhi during 1984-87. ICMR study reported 36.8% and 39.8% prevalence of hypercholesterolemia in the urban Delhi and rural Haryana respectively during 1991-94. Rural areas of Rajasthan had prevalence of 22% during 1991-93<sup>34</sup> while repeat cross-sectional surveys among urban subjects in Jaipur showed 37% vs 43% prevalence among men and women during 2001<sup>29</sup> and 33% vs 29% during 2002-03<sup>37</sup>. Mohan et al<sup>62</sup> carried out a study in the urban population of Chennai in south India during 1996-97 and the prevalence of hypercholesterolemia among low-income group was 14.2% while middle income group had a prevalence of 24.2%. A study in urban Kerala<sup>47</sup> reported 32% prevalence (criteria: >239mg%) during 1999. Two studies from Andhra Pradesh published in 2002 reported 18.5%<sup>76</sup> and 31%<sup>77</sup> prevalence of hypercholesterolemia respectively. The prevalence of hypercholesterolemia and mean levels of cholesterol levels Indian population are summarised in Table no 14 and 15. Prevalence of high LDL-Cholesterolemia, low HDL-Cholesterolemia and Hypertriglyceridemia are summarized in Table no 16, 18 and 20. Studies on their mean levels in Indian population are shown in Table no 17, 19 and 21. (*Refer Table 14-15 (Cholesterol).xls*) & (*Refer Table 16-21 (Lipid levels).xls*)

# Physical activity levels among Indian population

## Methodology of Search

Studies on Physical activity levels among Indian population were identified using a systematic medline search strategy from 1990 to 2005 as above. The search terms used were “physical inactivity”, “leisure-time exercise”, “sedentary life style”, “prevalence”, “coronary heart disease”, and “India”.

## Characteristics of identified articles

Using literature search techniques described earlier, we identified three cross sectional studies and one case control studies published between 1993 and 2005. The population groups involved in the cross sectional studies were industrial employees, and working population (employees of bank, public sector undertakings, software companies, factories, schools and colleges, executives, engineers)

## Cross-sectional studies

Few studies have estimated the physical activity levels in Indian population so far. Vaz et al<sup>130</sup> assessed the total and occupational physical activity status of school and college teachers in Bangalore, South India using a validated physical activity questionnaire among a convenient sample of 198 school and college teachers (females =173). The physical activity questionnaire provided information on estimated 24-hour energy expenditure (kJ/day) and Physical activity levels (PALs): a composite index of physical activity computed as estimated 24-hour energy expenditure (24h EE)/estimated basal metabolic rate (BMR). The specific cut-offs used for classification of physical activity levels using PALs were:  $\leq 1.4$  for sedentary;  $>1.4 - <1.55$  for mild activity;  $\geq 1.55 - \leq 1.6$  for moderate activity;  $>1.6 - \leq 1.75$  for moderately heavy activity; and  $>1.75$  for heavy activity. Table-22 shows the Distribution of estimated daily energy expenditure (kJ  $\pm$  SD) across various physical activity domains in male and female teachers and table-23 describes Physical activity pattern among teachers based on Physical Activity Levels (PAL) index. Majority of the individuals indulged in either a

sedentary or mild activity (PAL <1.55) and discretionary exercise was lower among women.

<b>Physical activity domains</b>	<b>Men (n = 25)</b>	<b>Women (n = 173)</b>
24 h energy expenditure	10576 $\pm$ 1873	8670 $\pm$ 1045**
Occupational	4845 $\pm$ 1323	3488 $\pm$ 801**
Discretionary exercise	806 $\pm$ 1457	259 $\pm$ 420**
Household chores	327 $\pm$ 570	1405 $\pm$ 1003**
Sleep	1793 $\pm$ 307	1461 $\pm$ 226**
Hobbies	57 $\pm$ 113	40 $\pm$ 86
'Residual' time	1755 $\pm$ 877	1353 $\pm$ 731**

*Statistical analysis: independent t-test; \*P < 0.05; \*\*P < 0.01*  
*The difference between the 24 h energy expenditure and the sum of the other domains is accounted for by discretionary activities, which are not 'exercise-related'.*

<b>Physical activity pattern</b>	<b>%</b>
True sedentary (PAL: $\leq$ 1.4)	12.1
Mildly active (PAL: >1.4- <1.55)	44.5
Moderately active (PAL: $\geq$ 1.55- $\leq$ 1.6)	13.1
Moderately heavy physical active (PAL: >1.6- $\leq$ 1.75)	20.7
Heavily active (PAL: >1.75)	9.6

The same authors<sup>131</sup> published the physical activity levels among working population in Bangalore among a convenience sample of 782 adults spanning an age range of 17 to 70 years. The physical activity pattern of each subject was assessed using a standard questionnaire, which provided a measure of overall physical activity computed as the Physical Activity Level (PAL) as well as activity related to specific physical activity domains. In the analysis of the latter, activity within a domain was expressed as MET.minutes, the product of the intensity and duration of activities within the specific activity domain. Table 24 summarises the physical activity patterns of the subjects, stratified for age among men and women.

	Sex	Age Groups				
		17-24	25-35	36-45	46-58	>58
Sample (782)	M/F	99/149	83/124	51/90	77/56	31/22
Body mass index (kg/m <sup>2</sup> )	M	20.9+/-2.9	23.2+/-3.3	23.5+/-2.5	23.2+/-3	23.2+/-4.1
	F	19.8 ± 2.8	21.8 ± 3.2	23.6 ± 4.0	24.2 ± 2.6	24.5 ± 3.7
Discretionary exercise (METS-min/day)	M	395+/-373	164+/-209	103+/-183	103+/-144	147+/-92
	F	104 ± 201	58 ± 101	79± 134	78 ± 111	98 ± 86
Household chores (METS-min/day)	M	56+/-83	52+/-80	47+/-85	55+/-92	50+/-70
	F	117 ± 157	317 ± 241	446 ± 246	413 ± 241	306 ± 239
Physical activity level (PAL)	M	1.64+/-0.21	1.56+/-0.18	1.49+/-0.18	1.5+/-0.21	1.22+/-0.07
	F	1.49 ± 0.15	1.56 ± 0.15	1.54 ± 0.18	1.54 ± 0.18	1.30 ± 0.13

The Sentinel surveillance<sup>102</sup> on CVD in Indian industrial population assessed the physical activity levels among the employees based on their perceived daily physical activity in the past five years. There was a broad heterogeneity in the levels of physical activity depending on the location of the industry. Physical activity levels were generally lower in Industries that were located in highly urbanized metropolitan cities such as Delhi, Hyderabad and Bangalore and were higher in predominantly semi-urban settings such as Assam and Nagpur and was intermediate in other areas. The figures are listed in table-25.

Sex	Category	Assam	Bangalore	Coimbatore	Delhi	Hyderabad	Ludhiana	Nagpur	Pune	Trivandrum	Lucknow	Total
Men	Very light	4.0	2.3	4.8	6.0	5.4	4.0	1.2	7.9	7.3	7.2	5.1
	Light	15.4	52.4	51.2	59.5	60.0	62.7	20.8	61.7	60.0	75.4	50.9
	Moderate	50.6	38.1	40.7	33.8	33.7	31.1	77.9	26.1	31.9	16.0	39.1
	Heavy	30.0	7.2	3.2	0.8	0.9	2.2	0.1	4.3	0.8	1.5	4.9
	Total	1189	901	1016	2348	872	824	1401	1158	1117	934	11760
Women	Very light	2.1	1.1	6.1	3.6	4.0	22.2	1.1	5.2	12.3	3.2	4.4
	Light	10.0	44.5	50.1	54.4	61.8	11.1	22.1	60.1	51.0	24.3	40.6
	Moderate	86.1	46.8	37.8	40.2	32.7	55.6	76.7	30.9	34.1	69.4	51.8
	Heavy	1.7	7.6	6.0	1.8	1.5	11.1	0.1	3.8	2.6	3.1	3.2
	Total	1211	785	879	1040	401	9	811	1095	894	748	7873



## Tobacco Prevalence in Indian Population

Studies carried out with the objective of providing the prevalence of tobacco use are scarce in India. Population-based surveys conducted in order to study risk factors for various diseases and mortality have reported information on tobacco use. Three major national surveys have collected limited tobacco use information. Occupational groups studied for tobacco use have included skilled and unskilled industrial workers, policemen, educational personnel, doctors, and white-collar workers/professionals, as shown in Table No- 25.

<b>Table No-25</b>						
<b>Tobacco use prevalence data from urban occupational group studies</b>						
Urban workers	Age(years)	Smoking (%)		Chewing(%)		Sample size
		M	F	M	F	
<b>Industrial workers<sup>150</sup></b>						
Ludhiana: Machine tool factory and woollen hosiery mill	17-64	50.2	-		-	473
Ahmedabad: Textile workers (mainly) 1967-1971 <sup>152</sup>	>35	35.6	-	27.1	-	57518
		22.1*				
<b>Policemen<sup>153</sup></b>						
Bombay(in 1969)	>26	26.9	-	47	-	3674
		11.6*				
<b>Media personnel<sup>159</sup></b>						
Patna: Press employees		10	-	52	-	300
		27*				
<b>Educational personnel</b>						
Chandigarh: Teachers <sup>146</sup>	30-64	19.3	-		-	347 /295
Hooghly District, WestBengal: Teachers <sup>155</sup>		73.9	13.9			257
Aligarh: University staff and research scholars <sup>162</sup>		33.3	-	20.6	30.4	2159/280
Lucknow: University teachers <sup>151</sup>		21.4	-			471/102
<b>Professionals and college students (Silliguri)<sup>147</sup></b>						
Professionals	18-25	53				588
College students		48.8				600
<b>Doctors</b>						

Chandigarh <sup>157</sup>		31.6 current	-		-	218
		23.3 former				
All-India meeting <sup>161</sup>		10 current	0	8	8	102/18
		9 occasional				
		14 former				
All-India meeting <sup>24</sup>	26-70	2.3	0			221/35
*smoking + chewing; M: male; F: female						

The Global Youth Tobacco Survey (GYTS), supported by the WHO and the Centers for Disease Control and Prevention (CDC), conducted during the years 2000-2004, was the first survey that provides data on youth (13-15 years) for national and international comparison with standardized methodology. The GYTS data are shown in Table no 26.

Prevalence	India	
	%	(95% CI)
Ever tobacco use	25.1	(±1.8)
Current tobacco use	17.5	(±1.5)
Current smokeless	16.6	(±1.5)
Current smoking	8.3	(±1.2)
Current cigarette smoking	4.2	(±1.2)
Current use of non-cigarette	13.6	(±1.0)
Smoker needs tobacco first thing in the morning	57.8	(±5.8)
<b>Second-hand smoke</b>		
Exposure (inside home)	36.4	(±1.6)
Exposure (outside home)	48.7	(±1.6)

The National Household Survey of Drug and Alcohol Abuse in India (NHSDAA), conducted in 2002 among males, covered over 40,000 individuals aged 12.60 years in nearly 20,000 households in 25 states (Table 27). The overall prevalence of current tobacco use from the NHSDAA was 55.8%.

	12-18 years	19-30 years	31-40 years	41-50 years	51-60 years
Sample(n)	8587	13216	7805	5920	5168
Tobacco users(n)	1860	7026	5186	4193	3638
Prevalence	55.8	54.9	67.6	72.0	71.5

In India, the National Sample Survey Organization (NSSO) has been conducting yearly surveys since 1950. Tobacco use is part of the consumer behavior component of the National Sample Survey (NSS), conducted every five years (Table No-28). Another nationwide survey, the National Family Health Survey (NFHS), in its second round (1998-1999), collected information on tobacco use (Table No-29). State-wise prevalence using the data of the NFHS-2 are shown in Table No-30. NSS data on the prevalence of tobacco use per 1000 individuals aged 10 years and above in different states and union territories are given Table No-31. The variations in tobacco use prevalence that exist between states are evident. Prevalence of tobacco use reported from other population based studies are summarized in Table no-32. (Refer Table 32 (Smoking).xls)

<b>Table No-28</b>				
<b>Age-specific prevalence (%) among males and females of regular tobacco users in rural and urban areas (NSS 1993-1994)</b>				
Age group (years)	Male		Female	
	Rural	Urban	Rural	Urban
10-14	1.3	0.4	0.9	0.2
15-24	19.1	8.7	4.6	1.2
25-44	61.3	40.7	12.2	4.5
45-59	72.3	50.9	20.4	11.4
60+	65.0	39.5	21.2	13.0
Total	43.0	27.7	10.9	4.7

<b>Table No-29</b>				
<b>Age-specific prevalence of tobacco use in males and females (NFHS-2)</b>				
Age group (years)	Male		Female	
	Chew tobacco	Currently smoke	Chew tobacco	Currently smoke
15-19	9.4	4.4	2.1	0.2
20-24	20.3	13.7	4.3	0.6
25-29	28.0	25.1	8.0	1.1
30-39	34.1	37.6	12.3	2.2
40-49	35.6	45.0	18.6	4.0
50-59	35.4	45.3	22.8	5.7
60+	37.6	38.6	25.0	5.3

Total	28.3	29.4	20.5	16.2
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Table No-30 State-level prevalence of tobacco smoking and chewing in India by sex (age 15 years and above) <sup>156</sup>								
Region/state	Smoking				Chewing			
	Men		Women		Men		Women	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
<i>North</i>								
New Delhi	23.9	22.0-25.9	1.8	1.4-2.2	13.1	11.5-14.9	2.5	1.9-3.2
Haryana	40.4	37.7-43.1	3.5	2.8-4.3	8.1	6.7-9.8	0.9	0.6-1.3
Himachal Pradesh	38.6	36.6-40.6	2.4	1.8-3.1	7.8	6.7-9.1	0.5	0.3-0.8
Jammu & Kashmir	44.3	42.0-46.6	8.3	7.1-9.7	7.3	5.8-9.1	0.9	0.6-1.3
Punjab	13.9	12.2-15.8	0.3	0.2-0.5	9.3	8.0-10.8	0.2	0.1-0.4
Rajasthan	37.8	35.7-39.9	4.1	3.2-5.2	19.0	17.7-20.4	3.8	2.9-4.9
<i>Central</i>								
Madhya Pradesh	29.4	27.6-31.1	0.9	0.6-1.2	40.3	38.7-42.0	14.4	12.7-16.2
Uttar Pradesh	33.8	32.5-35.2	3.0	2.6-3.5	36.3	34.6-38.0	10.9	10.1-11.8
<i>East</i>								
Bihar	26.3	24.8-27.9	6.2	5.5-7.0	51.8	50.1-53.5	6.7	6.0-7.6
Orissa	25.2	23.2-27.2	0.9	0.7-1.2	49.0	46.7-51.4	34.3	31.9-36.9
West Bengal	39.4	37.4-41.5	2.5	2.0-3.2	23.2	20.9-25.6	15.1	13.5-17.0
<i>North-East</i>								
Assam	31.5	28.4-34.9	2.6	2.0-3.4	47.8	44.7-51.0	24.3	22.1-26.6
Arunachal Pradesh	25.6	23.1-28.2	5.6	4.2-7.3	51.6	47.9-55.3	33.1	29.6-36.7
Manipur	35.0	32.0-38.1	12.0	10.0-14.2	34.1	31.1-37.3	19.2	15.5-23.5
Meghalay	55.2	50.6-59.7	6.7	4.2-10.6	16.9	13.8-20.5	27.6	23.8-31.7
Mizoram	59.4	57.0-61.8	22.0	19.6-24.6	60.2	56.5-63.8	60.7	57.2-64.0
Nagaland	38.0	34.3-41.8	2.4	1.3-4.5	45.0	41.3-48.8	16.5	13.7-19.7
Sikkim	19.4	17.1-22.0	8.2	6.9-9.7	39.5	36.5-42.7	18.6	16.2-21.2
Tripura	48.5	44.9-52.2	9.7	6.7-13.9	10.8	8.9-13.1	5.2	3.3-8.1
<i>West</i>								
Goa	17.8	16.1-19.6	2.0	1.2-3.2	7.7	6.0-9.9	8.0	6.3-10.2
Gujarat	25.3	23.5-27.2	1.4	1.0-1.8	24.6	22.8-26.4	8.0	7.0-9.2
Maharashtra	13.3	12.1-14.6	0.2	0.1-0.4	34.1	32.3-36.0	18.0	16.1-20.0
<i>South</i>								
Andhra Pradesh	35.4	33.4-37.5	4.2	3.5-4.9	10.7	9.4-12.0	9.9	8.4-11.7
Karnataka	25.7	24.1-27.4	0.3	0.2-0.4	13.8	12.1-15.6	14.1	12.7-15.7

Kerala	28.2	26.5-30.0	0.4	0.3-0.7	9.4	8.3-10.7	10.1	9.1-11.2
Tamil Nadu	27.0	25.4-28.8	0.3	0.2-0.6	12.9	11.5-14.5	10.7	9.3-12.2

<b>Table No-31</b>				
<b>Prevalence of tobacco use in any form by ever-users per 1000 rural and urban males and females (10+ years of age), States and Union Territories, India, NSS, 1993-1994<sup>154</sup></b>				
State	Male		Female	
	Rural	Urban	Rural	Urban
	Tobacco users (%)	Tobacco users (%)	Tobacco users (%)	Tobacco users (%)
Andhra Pradesh	43.9	26.2	12.3	4.1
Arunachal Pradesh	47.9	37.5	28.8	16.2
Assam	52.7	44.6	11.1	5.3
Bihar	47.6	33	6	3.6
Goa	22	23.8	5.5	4.2
Gujarat	42.9	28.6	9.1	3.5
Haryana	46.8	33.7	6.2	2.1
Himachal Pradesh	41.7	28.1	3.8	3.1
Jammu and Kashmir	38.2	19.8	3.2	0.5
Karnataka	36.6	24	9.6	3.2
Kerala	34.6	31.5	6.7	4.6
Madhya Pradesh	54	33.6	12	7.2
Maharashtra	45.4	25.4	24	8
Manipur	45.5	35.4	21.5	13.2
Meghalaya	62.2	53.2	31.9	13.1
Mizoram	69.8	66.9	63.2	57.4
Nagaland	31.9	34.1	1.7	-
Orissa	56.2	41.8	44.8	24.1
Punjab	12.8	18	0.3	0.3
rajasthan	45.8	31.4	4.8	3.8
Sikkim	52.6	36.2	4.6	0.6
Tamil Nadu	28.4	23.4	9.2	4
Tripura	56.1	50.7	21.1	24.6
Uttar Pradesh	47.6	31.5	7.7	3
West Bengal	52.7	44.4	10.6	6.6
Andaman and Nicobar	53.3	43.4	19.9	9.7
Chandigarh	38.1	30.2	1.3	1.3
Dadra and Nagar Haveli	56.7	28.2	5.6	3.1
Daman-Diu	26.8	21	7.2	0.5
Delhi	43.4	25.2	3.5	1.4
Lakshadweep	38.3	43.5	21.4	14.9
Pondicherry	23.2	16.6	4.8	2.1
All India	45.3	29.9	11.8	5.1

## Prevalence of Rheumatic heart disease in Indian population

Rheumatic heart disease (RHD) is a common cardiovascular ailment, affecting children and young adults. The prevalence of RHD has declined in the developed countries; but continues to be an important cause of cardiovascular morbidity and mortality in India among the younger age group. As per ICMR studies<sup>110</sup>, the prevalence of RHD varies from 1.0 to 5.4/1000 schoolchildren during the eighties. In the south Indian population, Vellore in Tamil Nadu had a 0.3% prevalence of RHD during 1982-90, which declined to 0.068% during 2001-02. Incidence figures are also available for RHD from various parts of India, which are summarized in the table-33. The incidence estimates are predominantly in north Indian population. It ranges from 0.17 to 0.75 per 1000 population. The details are given in the Table no 34.

<b>Table No-33</b>						
<b>Prevalence of Rheumatic Heart Disease in Indian Population</b>						
<b>Place</b>	<b>Type</b>	<b>Year</b>	<b>Age Group</b>	<b>Prevalence (%)</b>	<b>Sample Size</b>	<b>Ref</b>
Ballabgarh		1982-90	5-14	0.1	13509	110
Varanasi		1982-90	5-14	0.54	12190	110
Vellore		1982-90	5-14	0.29	13509	110
Raipurrani		1988-91	5-14	0.21	31200	111
Delhi	U	1984-94	5-9	0.39	40000	112
Ludhiana		1987	6-16	0.13	6005	113
Gujrat, Anand		1986	8-18	0.203	11346	114
Kanpur		2000	7-15	0.454	3963	115
Tamil Nadu, Vellore		2001-02	6-18	0.068	229829	116

<b>Table No-34</b>					
<b>Incidence of Rheumatic Fever in India per 1000</b>					
<b>Place</b>	<b>Year</b>	<b>Age group</b>	<b>Incidence</b>	<b>sample size</b>	<b>Ref</b>
Delhi	1984-94	5-10	0.384	40000	112
Anand	1986	8-18	0.176	11346	114
Ludhiana	1987	6-16	0.700	6005	113
Raipurani	1988-91	5-15	0.540	31200	111

Kanpur	2000	7-15	0.750	3963	115
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## Prevalence of Stroke in Indian population

Cerebrovascular diseases play an important worldwide role in the morbidity and mortality of adults posing serious medical, socio-economic and rehabilitation problems. The earliest report on prevalence of stroke in India was from Vellore<sup>132</sup>, which estimated 0.56 per 1000 prevalence of stroke. During 1982-84, Gouri Devi et al<sup>133</sup> carried out a study in Karnataka which estimated 1.18/1000 and 0.98/1000 prevalence in the urban and rural areas respectively. During 1993-95<sup>141</sup> the prevalence rose to 1.514 per thousand in Karnataka. Bharuch et al<sup>135</sup> carried out a study among the Parsi community of Bombay which reported a stroke prevalence of 4.24/1000 during 1995. The Bombay study; however, was confined to a particular community- Parsi, which is an affluent society and their standard of living and life expectancy is comparable to that of developed countries. East Indian<sup>138</sup> population had a prevalence of 1.47/1000, while Kashmir<sup>136</sup> had a prevalence of 2.44 per 1000. In a north Indian population prevalence of stroke was found to be 0.44/1000 population in Rohtak. Reviews of Anand et al and Dalal PM based on prevalence studies in India suggest the prevalence of stroke in Indian population to be two per one thousand individuals. The figures are shown in the Table No-35. *(Refer Table 35 (Stroke).xls)*

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