Time-trends in Prevalence and Awareness of Cardiovascular Risk Factors in an Asymptomatic North Indian Urban Population

Manish Bansal*, Sameer Shrivastava#, Rahul Mehrotra*, Vinayak Agrawal*, Ravi R Kasliwal**

Abstract
Objective: To determine temporal changes in the prevalence and level of awareness of cardiovascular risk factors (CVRFs) in an asymptomatic North-Indian urban population.

Methods: All asymptomatic office executives who underwent routine health check-up at a tertiary care centre in India during the year 2000 (n=2226) and the year 2005 (n=2684) were included in the study. Clinical evaluation including history of CVRFs, anthropometry, blood pressure measurement and biochemical investigations (fasting and postprandial blood glucose and fasting lipid profile) were performed in all the subjects.

Results: Mean age of the subjects was 51.3±9.8 years in the year 2000 and 40.1±12.2 years in the year 2005 (p <0.001). Of all the subjects, 83.2% in the year 2000 were males compared to 76.8% in the year 2005 (p <0.001). Age- and sex- adjusted prevalence of hypertension, diabetes, impaired fasting glucose and metabolic syndrome was higher in the year 2005 as compared to 2000 (odds ratios- 1.3, 1.82, 6.55 and 1.82 respectively; all p values <0.05). In contrast, prevalence of low HDL-cholesterol, smoking and family history of premature coronary artery disease decreased by the year 2005 (odds ratios- 0.54, 0.60 and 0.67; all p-values <0.001), whereas prevalence of dyslipidemia remained same (odds ratio- 0.89, p-value 0.11) during the same period. As compared to year 2000, in the year 2005 there was significant improvement in the awareness of hypertension (46.9% vs 56.7%, p value <0.001) and dyslipidemia (5.4% vs 9.6%, p value <0.001) but not of diabetes (67.0% vs 71.3%, p-NS).

Conclusions: The present study shows that in the office-executives belonging to urban North-Indian region, prevalence of most of CVRFs is markedly high and is increasing with time. In addition, a significant proportion of these individuals are not aware of their risk status though there has been an improvement in awareness level of hypertension and dyslipidemia over the five-year period from the year 2000 to 2005.
defined according to JNC 7 guidelines as systolic blood pressure (SBP) ≥ 140 mm Hg or diastolic blood pressure (DBP) ≥ 90 mm Hg or self-reported use of anti-hypertensive medications. Diabetes mellitus was defined as fasting blood glucose ≥ 126 mg/dl or 2-hour postprandial blood glucose ≥ 200 mg/dl or pharmacological treatment for diabetes. In patients without diabetes mellitus, impaired fasting glucose (IFG) was diagnosed if the fasting blood glucose level was 100-125 mg/dl and impaired glucose tolerance (IGT) was diagnosed if 2-hour postprandial blood glucose was 140-199 mg/dl.

Dyslipidemia was defined as presence of at least one of the following lipid abnormalities: high total cholesterol (> 200 mg/dl), high serum triglycerides (> 150 mg/dl) and low high density lipoprotein-cholesterol (HDL-C, <40 mg/dl in men and <50 mg/dl in women). Family history was considered positive if a male first degree relative had had a coronary event before the age of 55 years and a female first degree relative before the age of 65 years. Current smoking or tobacco use in any form was also considered to be a CVRF.

Diagnosis of metabolic syndrome

Metabolic syndrome (MS) was diagnosed using the recently updated ATP III criteria that require presence of any three of the following five criteria to constitute a diagnosis of MS: a) BP >130 mm Hg systolic or > 85 mm Hg diastolic or already on antihypertensive drug treatment, b) serum triglycerides > 150 mg/dl or on drug treatment for elevated triglyceride levels, c) HDL-C <40 mg/dl in men and <50 mg/dl in women, d) fasting blood glucose > 100 mg/dl or on drug treatment for elevated blood glucose and e) waist circumference greater than the cut-offs specified for the specific population. Since waist circumference was not available for all the patients in our study, we used body mass index (BMI) ≥ 25.0 kg/m² as a marker of obesity instead of waist circumference. The cut-off value of ≥ 25.0 kg/m² was used in accordance with the recommendations of the American Association of Clinical Endocrinologists for the diagnosis of MS. In addition, as most of the guidelines have recommended lower thresholds to define obesity in Asian populations and a much lower cut-off values for BMI has been proposed by various investigators, we estimated prevalence of MS (MS23) using a lower BMI (≥ 23.0 kg/m²) cut-off also.

Statistical Methods

The data was managed on Microsoft excel spreadsheet (version 2003, Microsoft Corp, Seattle, Washington). Values were expressed as mean (± standard deviation) or as percentages. Comparisons between the groups were done using Student’s unpaired t test or chi-square test wherever appropriate. A p value <0.05 was considered statistically significant. All statistical analyses were done using SPSS for Windows (release 14.0, SPSS Inc).

Results

Mean age of the subjects during the year 2000 was 51.3±9.8 years as compared to 40.1±12.2 years during 2005 (p <0.001), likely to be a reflection of increasing tendency to get preventive health check-ups done at a younger age. In addition, higher proportion of the subjects were males during the year 2000 (83.2%) compared to the year 2005 (76.8%, p <0.001). To address these differences, age- and sex-adjusted values of all the variables were used for comparison between the two groups.

Prevalence of Various Conventional and Non-conventional CVRFs in the Two Groups

Unadjusted as well as age- and sex-adjusted values of all the clinical and biochemical characteristics of the two groups are presented in Tables 1A and 1B.

Hypertension

Nearly half (49.9%) of all the individuals during the year 2000 had hypertension. Although the prevalence was lower (36.4%) during the year 2005, after correction for age and gender discrepancies, the subjects were more likely to have hypertension during the year 2005 than during the year 2000 [odds ratio 1.3 (95% CI 1.14-1.5), p <0.001].

Diabetes Mellitus, IFG and IGT

The prevalence of abnormalities of glucose homeostasis was alarmingly high during the year 2005 with 37.9% of all the individuals having either diabetes mellitus or IFG. Both diabetes mellitus and IFG were significantly more common in the year 2005 [odds ratios 1.82 (95% CI 1.5-2.2) and 7.61 (95% CI 5.95-9.73) respectively, p values <0.001 for both] than in the year 2000 but there was no significant difference in the prevalence of IGT in the two groups [odds ratio 1.3 (95% CI 0.91-1.86), p value 0.15].

Lipid Abnormalities

Individuals during the year 2005 had higher serum levels of total cholesterol, LDL-C, triglycerides and HDL-C. Hence, the prevalence of low HDL-C was lower [odds ratio 0.54 (95% CI 0.47-0.62), p value <0.001] and of high triglycerides higher
However, the overall age- and sex-adjusted prevalence of dyslipidemia was similar during the two time periods [odds ratio for the year 2005- 0.89 (95% CI 0.77-1.03), p value 0.11].

Obesity and Metabolic syndrome

Individuals during the year 2005 had higher BMI (25.2±3.9 vs 24.6±3.8 kg/m²), age and sex-adjusted p value <0.001) as compared to those during the year 2000 and had higher prevalence of MS [odds ratio 1.82 (95% CI 1.59-2.08), p value <0.001]. During the year 2005, 42.9% of all the individuals had MS and the prevalence was much higher (51.1%) using the lower BMI cut-off value (≥ 23.0 kg/m²) as described above.

Other Risk Factors

Smoking was less common during the year 2005 [odds ratio

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Table 1B: Clinical and biochemical characteristics in the two groups- Categorical variables

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Year 2000 (n=2226)</th>
<th>Year 2005 (n=2684)</th>
<th>Unadjusted OR (95% CI)</th>
<th>p-value</th>
<th>Adjusted prevalence in year 2005</th>
<th>Adjusted OR (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>1111 (49.9%)</td>
<td>978 (36.4%)</td>
<td>0.58 (0.51-0.65)</td>
<td>&lt;0.001</td>
<td>56.4%</td>
<td>1.3 (1.14-1.5)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>275/2194 (12.5%)</td>
<td>276/1927 (14.3%)</td>
<td>1.17 (0.98-1.4)</td>
<td>0.09</td>
<td>20.7%</td>
<td>1.82 (1.5-2.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>1689 (75.9%)</td>
<td>1907 (71.1%)</td>
<td>0.78 (0.69-0.89)</td>
<td>&lt;0.001</td>
<td>73.7%</td>
<td>0.89 (0.77-1.03)</td>
<td>0.11</td>
</tr>
<tr>
<td>Smoking</td>
<td>494 (22.2%)</td>
<td>395 (15.1%)</td>
<td>0.61 (0.52-0.70)</td>
<td>&lt;0.001</td>
<td>14.6%</td>
<td>0.60 (0.51-0.72)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Family history of premature CAD</td>
<td>321 (14.4%)</td>
<td>260 (9.7%)</td>
<td>0.64 (0.54-0.76)</td>
<td>&lt;0.001</td>
<td>10.1%</td>
<td>0.67 (0.55-0.82)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>IFG</td>
<td>105/1919 (5.5%)</td>
<td>389/1651 (23.6%)</td>
<td>5.33 (4.24-6.68)</td>
<td>&lt;0.001</td>
<td>30.6%</td>
<td>7.61 (5.95-9.73)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>IGT</td>
<td>81/1919 (4.2%)</td>
<td>62/1651 (3.8%)</td>
<td>0.89 (0.63-1.24)</td>
<td>0.48</td>
<td>5.4%</td>
<td>1.3 (0.91-1.86)</td>
<td>0.15</td>
</tr>
<tr>
<td>Low HDL-C</td>
<td>1050 (47.2%)</td>
<td>1060 (39.5%)</td>
<td>0.73 (0.65-0.82)</td>
<td>&lt;0.001</td>
<td>32.5%</td>
<td>0.54 (0.47-0.62)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>High TG</td>
<td>751 (33.7%)</td>
<td>952 (35.5%)</td>
<td>1.08 (0.96-1.21)</td>
<td>0.2</td>
<td>42.3%</td>
<td>1.44 (1.26-1.65)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Body-mass index &gt; 25.0 kg/m²</td>
<td>855/1964 (43.5%)</td>
<td>1301/2621 (49.6%)</td>
<td>1.28 (1.14-1.44)</td>
<td>&lt;0.001</td>
<td>55.5%</td>
<td>1.62 (1.42-1.86)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>MS</td>
<td>803/2139 (37.5%)</td>
<td>1066/2484 (42.9%)</td>
<td>1.25 (1.11-1.41)</td>
<td>&lt;0.001</td>
<td>52.2%</td>
<td>1.82 (1.59-2.08)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>MS_{33}</td>
<td>953/2140 (44.5%)</td>
<td>1250/2447 (51.1%)</td>
<td>1.3 (1.16-1.46)</td>
<td>&lt;0.001</td>
<td>60.0%</td>
<td>1.87 (1.64-2.14)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Fig. 1: Level of awareness about the presence of different cardiovascular risk factors in the study population during the years 2000 and 2005.

[odds ratio 1.44 (95% CI 1.26-1.65), p value <0.001] in the year 2005. However, the overall age- and sex-adjusted prevalence of dyslipidemia was similar during the two time periods [odds ratio for the year 2005- 0.89 (95% CI 0.77-1.03), p value 0.11].

Obesity and Metabolic syndrome

Individuals during the year 2005 had higher BMI (25.2±3.9 vs 24.6±3.8 kg/m²), age and sex-adjusted p value <0.001) as compared to those during the year 2000 and had higher prevalence of MS [odds ratio 1.82 (95% CI 1.59-2.08), p value <0.001]. During the year 2005, 42.9% of all the individuals had MS and the prevalence was much higher (51.1%) using the lower BMI cut-off value (> 23.0 kg/m²) as described above.

Other Risk Factors

Smoking was less common during the year 2005 [odds ratio...
0.60 (95% CI 0.51-0.72), p value <0.001] than during the year 2000. Family history of premature CAD was also less common during the year 2005 [odds ratio 0.67 (95% CI 0.55-0.82), p value <0.001].

Awareness of Presence of Various CVRFs in the Two Groups (Figures 1 and 2)

Nearly half of all the individuals with hypertension in 2000 and 2005 were not aware of the fact that they had high BP. However, the proportion was greater during the year 2000 as compared to the year 2005 (56.7% vs 46.9%, p value <0.001). In addition, during both the years- 2000 and 2005, only half of all the individuals who were aware of their hypertensive status were receiving treatment for the same.

The level of awareness was much better for diabetes mellitus, with nearly two-third of all the individuals being aware of their diabetic status (71.3% in the year 2000 vs 67.0% in 2005, p- NS). With regard to dyslipidemia, only 5.4% patients with dyslipidemia were aware of their dyslipidemic status during the year 2000 but the level of awareness had increased significantly by 2005 (9.6%, p- <0.001).

Since age is likely to influence the level of awareness of the presence of CVRFs among individuals, we determined the level of awareness in three different age groups- 35 years or less, 36-50 years and >50 years (figure 2). During the year 2000, awareness of hypertension and diabetes did not increase with age but that of dyslipidemia significantly improved with age (p 0.02). In contrast, during the year 2005, awareness of both hypertension and dyslipidemia rose significantly with age (p value <0.001 for both). In subjects above 35 years of age, level of awareness about both hypertension and dyslipidemia was significantly higher during 2005 as compared to the year 2000.
Discussion

The salient findings of the present study are- 1) In asymptomatic, office-executives residing in an urban North-Indian region, the prevalence of most of the CVRFs is markedly high, 2) there has been an increase in the prevalence of these CVRFs during the five year period from 2000 to 2005, 3) a significant proportion of the these individuals are not aware of their risk status, and 4) there has been an increase in awareness about the presence of hypertension and dyslipidemia during the five year period from 2000 to 2005.

Current Prevalence of CVRFs

Few studies have reported the prevalence of CVRFs in urban populations in India in the recent times. In a study involving industrial population in the neighborhood of Delhi, Prabhakaran et al found that hypertension was present in 30%, diabetes in 15%, high serum total cholesterol/ HDL-C ratio in 62% and metabolic syndrome in 35% individuals. The mean age of the study population was 42 years which was similar to our population.7 In yet another study carried out on the industrial population, Mehan et al found equally high prevalence of most of the CVRFs, esp. diabetes (19.1%) and hypertension (38.2%).8 Gupta et al reported prevalence of CVRFs in an urban population in Jaipur. Hypertension was seen in 37.3%, high triglycerides in 30.4%, low HDL-C in 55.0%, diabetes in 12.3%, overweight (BMI > 25.0 kg/m2) in 44.2% and MS in 31.6% subjects.9,10 In another study in Jaipur involving Punjabi Bhatia community, Gupta et al found hypertension in 51.5%, diabetes in 16.8% and MS in 42.6%.11

Studies from the Southern region of India have also reported high prevalence of CVRFs. In a study involving industry workers and their family members in Chennai, Mohan et al found prevalence of diabetes to be 11.9%, hypertension 25.4%, overweight (BMI > 23.0 kg/m2) 60.2% and metabolic syndrome 34.1%.12 Another study on the industrial population in Chennai reported hypertension to be present in 27.2%, diabetes in 16.3%, current smoking in 20.2% and found 66.8% of this populace to be overweight (BMI > 23.0 kg/m2).13 In a recent study carried out on physicians (mean age 39.0 years), Ramachandran et al also reported high prevalence of CVRFs (hypertension 35.6%, diabetes 13.3%, IGT 10.7%, high triglycerides 33.4%, low HDL-C 31.9% in men and 58.5% in women and MS in 29.0%).14 It is important to note that in all these studies, > 110 mg/dl was used as the cut-off for IFG for defining MS which is likely to have lowered the prevalence of MS in the studied populations. Thus the findings of our study are in accord with the data from studies involving similar populations as ours.

Reddy et al have recently reported prevalence of CVRFs among industry workers and their family members from 10 large industries from different parts of India.15 This is the largest reported study in this population subset. In this study, hypertension was present in 29.3%, diabetes in 11.2% and high triglycerides in 32.2% men. Since our study population was predominantly male, these figures are close to but somewhat lower than the same in our study subjects in the year 2005. In contrast, prevalence of obesity (BMI > 25.0 kg/m2) and MS was substantially lower in this study (28.6% and 20.9%, respectively) as compared to ours. Inclusion of family members along with the employees and the differences in socioeconomic status of the study subjects could be the underlying reasons for these differences. In addition, use of BMI as a measure of obesity and a cut-off of > 100 mg/dl for defining FPG are also responsible for higher prevalence of MS seen in our study. However, in a recent study by Wasir et al in 2050 subjects with mean age 40 ± 18 years, prevalence of MS was found to be 49.2% using a modified ATP definition in which FPG cut-off of > 100 mg/dl was used and BMI was also included as a criterion for obesity.16

Prevalence of IFG

We found markedly high prevalence of IFG (23.6%) in our subjects during the year 2005. Most of the previous studies have used a cut-off of > 110 mg/dl for defining impaired fasting glucose as compared to more recently recommended value of > 100 mg/dl which was used in our study.17 However, in the afore-mentioned study, Wasir et al have reported prevalence of IFG using two different definitions.16 They found that IFG was present in ~11% subjects using the higher cut-off as compared to ~16% when the lower cut-off was used. Since this study included subjects from general community and had also included adolescents (18% of the total sample size), our finding of 23.6% prevalence of IFG is not surprising.

Time-trends in Prevalence of CVRFs

In a serial survey performed 7 years apart, Gupta et al reported significant increase in prevalence of diabetes, obesity, hypertension (in men), total- and LDL cholesterol and triglycerides and decrease in HDL cholesterol among general population in Jaipur. The increase was more marked in low educational status groups.18 In a similar study, prevalence of diabetes and obesity (BMI > 25.0 kg/m2) in Chennai in the year 2000 and 2006 were compared. There was significant increase in prevalence of both diabetes (from 13.9% to 18.6%) and obesity (from 29.8% to 40.8%) over the six-year period.19 Both the above-mentioned studies however involved general population which involved people from different socioeconomic and educational strata. As already mentioned above, Gupta et al found that the increase in prevalence of CVRFs was more marked in people belonging to low educational status.18 In our study, we included office-executives who belonged to relatively higher educational status and were relatively more affluent as compared to the above mentioned study populations, yet we found a significant trend towards increase in the CVRF burden.

Awareness of Prevalence of CVRFs

Although many studies have reported data about awareness among different population subsets of their cardiovascular risk, temporal changes in the level of awareness have not been reported. In the afore-mentioned study on physicians,14 31.6% of all cases of diabetes among the physicians were new cases as compared to 40.0% in the general population. In addition, 71% of all physicians and 72% of the general population with hypertension were unaware of their hypertensive status. Similarly, almost 40% cases of diabetes in the study by Ramachandran et al were newly diagnosed.19 In the study on industrial population neighboring Delhi, only a third of those who had hypertension (31.5%) and diabetes (31%) were aware of their status.7 Similar findings were noted in Chennai Urban Population Study also. Only a third of the patients were aware that they had hypertension and only half of those aware were on treatment for the same. In the present study, we have also found similar level of lack of awareness for the presence of hypertension, diabetes and dyslipidemia. More importantly, we found that whereas the awareness about hypertension and dyslipidemia had improved from the year 2000 to year 2005, there was no improvement in the awareness about diabetes over the same time period. In addition, although awareness about dyslipidemia had increased with time, the level was still very poor in the year 2005. These findings reflect poor tendency.
among asymptomatic persons to undergo blood testing esp. lipid levels to get their cardiovascular risk assessed. Another worrisome finding of our study was that almost half of the hypertensive individuals, who were aware of their hypertensive status, were not on treatment for the same in the year 2005, a figure which had not improved since the year 2000.

Limitations

The major limitation of the present study is that this was a hospital-based survey and therefore may not represent true status of the cardiovascular risk of office-executives as a whole. A community-based study involving random sampling of subjects from the same community over two time-periods would have been ideal to address the research issue in consideration. However, the individuals who were enrolled in the present study were those who had undergone health check-up as part of preventive health program of their respective organizations and not because of the fact that they were already having one or more risk factors for CVD. The finding of similar prevalence of CVRFs in the present study as other previous studies supports our assumption that our data provide a reasonable estimate of cardiovascular risk status of office-executives in this region. Therefore it is unlikely that the present methodology would have resulted in any significant bias in our findings. However, owing to involvement of subjects belonging to only select socioeconomic stratus, our data cannot be applied to general population at large. Nonetheless, our study, being one of the largest to have addressed these issues, brings out useful information of public health importance.

Unfortunately, in the present study, we could not obtain adequate information about some of the recently recognized important risk factors for South Asians such as fruits and vegetable intake, psychosocial stress, physical activity etc. Wide subjective variations in assessment of these risk factors and lack of information about these risk factors in the majority of the studied population precluded us from including this information in the present report. In addition, we also did not have detailed information about socioeconomic status and level of education in these individuals. We acknowledge these limitations to our study.

Conclusions

The present study shows that in the office-executives belonging to urban North-Indian region, prevalence of most of CVRFs is markedly high and is increasing rapidly with time. Also, a significant proportion of these individuals are not aware of their risk status. These findings assume greater significance if we consider that these individuals belong to relatively affluent social stratum, are likely to be more educated and have greater access to healthcare as compared to the general population. Although increasing tendency to get preventive health check-ups done at younger age and consequent increase in awareness about some of these risk factors are encouraging findings, further motivation to undertake measures towards prevention of CVD, including timely risk evaluation, are urgently needed.

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References