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Surveillance for risk factors of cardiovascular disease among an industrial population in southern India

V. MOHAN, M. DEEPA, S. FAROOQ, D. PRABHAKARAN, K. S. REDDY

ABSTRACT

Background. We assessed (i) the risk of cardiovascular disease in an industrial population in Chennai, southern India and (ii) whether the status of treatment and control of diabetes and hypertension would be different in an industrial population, which is provided free healthcare, compared with the general population of Chennai.

Methods. Subjects residing in the residential areas of 2 industries (Indian Airlines and Integral Coach Factory) in Chennai in southern India were recruited. The subjects were employees ($n = 440$) selected by an age- and sex-stratified random sampling method, and their family members ($n = 727$) in the age group of 20–69 years; a total of 1167 subjects. Fasting plasma glucose, lipid estimations and anthropometric measurements were done in all the subjects. Information on demographic and lifestyle determinants was obtained using a questionnaire. Diabetes was diagnosed using the American Diabetes Association criteria and metabolic syndrome was defined by the Adult Treatment Panel III criteria with modified waist definition for Asian Indians.

Results. Age-adjusted prevalence of major risk factors for cardiovascular disease using the 2001 Census of India were as follows: diabetes 11.9%; hypertension 25.4%; dyslipidaemia 40.2%; hypertriglyceridaemia 28.3%; overweight (body mass index ≥ 23 kg/m^2) 60.2%; and metabolic syndrome 34.1%. Use of tobacco in any form was present in 22.9% of men and 0.5% of women; 79% of the subjects followed a sedentary lifestyle. Among subjects receiving medication, 42.1% of subjects with diabetes and 55.3% of subjects with hypertension had their disease under adequate control. A comparison of these results with the general population of Chennai showed that the industrial population had a higher prevalence of cardiovascular risk factors in spite of having better access to healthcare facilities.

Conclusions. The prevalence of cardiovascular disease was high in this industrial population of Chennai. Although the overall treatment and control of diabetes and hypertension was better than that in the general population, it was still inadequate and this emphasizes the need for greater awareness about non-communicable diseases.

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INTRODUCTION

Cardiovascular disease (CVD) is predicted to be the most common cause of death globally, including in India, by 2020.[1] The prevalence of CVD and its risk factors are high in migrant people of Asian Indian origin compared with the host population.[2,3] The growing burden of CVD[4] is due to the increasing prevalence of cardiovascular risk factors such as diabetes, hypertension, dyslipidaemia, overweight or obesity, physical inactivity and use of tobacco. It is known that CVD occurs at least a decade earlier in Asian Indians compared

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with Europeans.[5] India also perhaps suffers the highest loss in potentially productive years of life, as deaths due to CVD in persons in the age group of 35–64 years is high.[6] It is predicted that by the year 2015, India will have the largest burden of CVD in the world.[7] Over time, the prevalence of many risk factors for CVD is also likely to increase in developing countries due to higher levels of smoking, overweight, diabetes and high blood pressure. A range of factors contribute to this trend including the impact of industrialization, urbanization, globalization and affluence.[6] Further, reversal of the social gradient (an inverse relationship of risk factors of CVD to the level of socioeconomic status and education) has been observed for certain risk factors (such as diabetes, impaired glucose tolerance, hypertension, obesity, hypercholesterolaemia and hyper-insulinaemia) in India. Hence, it would be useful to assess the burden of risk factors for CVD among individuals with a higher level of education than the general population and who have access to healthcare. As Indians have a higher prevalence of premature CVD, it would be useful to assess the prevalence of risk factors of CVD in people in the working age group and in settings where adequate healthcare facilities are available. This study was designed to identify risk factors for CVD in an industrial population in Chennai in southern India.

METHODS

Study design

The study was done in the residential colonies of Indian Airlines and the Integral Coach Factory located in the metropolitan city of Chennai (formerly Madras) in southern India, which has a population of 5 million. Employees from these 2 industries and their family members were selected based on the age- and sex-stratified random sampling method (in each decile starting from 20–29 years to 60–69 years). The subjects included randomly selected employees (n=440) and their eligible family members (n=727) in the age group of 20–69 years, i.e. 1167 adults living in the 2 colonies of these industries. A detailed questionnaire was administered, anthropometric measurements were obtained and biochemical estimations were done in all the eligible subjects. The questionnaire obtained information regarding demographic and lifestyle-related aspects associated with major risk factors of CVD and their past medical history. All questions in the questionnaire were tested in a pilot study for clarity and 'face validity' ('Does the question refer to what it intends to seek?') and then the final version of the questionnaire was developed. Also, the questionnaire was pilot-tested for data quality and the questions were modified and finalized based on the results of the pilot study.

The institutional ethics committee approved the study and informed consent was obtained from all the subjects.

Fasting plasma glucose was measured in all the subjects. The fasting blood sample was taken, after ensuring 8 hours of overnight fasting, for estimation of plasma glucose and serum lipids using a Hitachi 912 autoanalyser (Roche Diagnostics GmbH, Mannheim, Germany). Anthropometric measurements including weight, height, waist and hip measurements were obtained using standardized techniques as described.

Height was measured with a tape to the nearest centimetre. The subjects were asked to stand upright without footwear with their back against the wall, heels together and eyes directed forward.

Weight was measured with a traditional spring balance that was kept on a firm horizontal surface. Subjects were asked to wear light clothing and weight was recorded to the nearest 0.5 kg.

Body mass index (BMI) was calculated using the formula: weight (kg)/height (m)^2.

Waist circumference was measured using a non-stretchable measuring tape. The subjects were asked to stand erect in a relaxed position with both feet together on a flat surface; one layer of clothing was accepted. Waist girth was measured as the smallest horizontal girth between the costal margins and the iliac crests at minimal respiration.

Blood pressure was recorded in the sitting position in the right arm to the nearest 1 mmHg using an electronic OMRON machine (Omron Corporation, Tokyo, Japan). Two readings were taken 5 minutes apart and the mean of the 2 readings was used for analysis.

Definitions

Diabetes. The diagnosis of diabetes was based on the American Diabetes Association (ADA) definition, i.e. fasting plasma glucose ≥126 mg/dl (≥7.0 mmol/L) or subjects who reported that they had diabetes and were on treatment by a physician.[8]

Hypertension. Hypertension was diagnosed based on drug treatment for hypertension or if the blood pressure was ≥140/90 mmHg (JNC-7 criteria).[9]

Dyslipidaemia. The National Cholesterol Education Programme (NCEP) guidelines[10] were used for the definition of dyslipidaemia.

Hypercholesterolaemia was diagnosed if the serum cholesterol levels were ≥200 mg/dl (≥5.2 mmol/L) or if the subjects were receiving drugs for the treatment of hypercholesterolaemia.

Hypertriglyceridaemia was diagnosed if serum triglyceride levels were ≥150 mg/dl (≥1.7 mmol/L) or if the subjects were receiving drugs for the treatment of hypertriglyceridaemia.

Low high-density lipoprotein (HDL) cholesterol was diagnosed if HDL cholesterol levels were <40 mg/dl (<1.04 mmol/L) for men and <50 mg/dl (<1.3 mmol/L) for women.

High low-density lipoprotein (LDL) cholesterol was diagnosed if LDL cholesterol levels were >130 mg/dl (>3.3 mmol/L).

High total cholesterol (TC) to HDL cholesterol ratio (TC/HDL) was diagnosed if the ratio was ≥4.5.

Metabolic syndrome was defined based on the National Cholesterol Education Programme and Adult Treatment Panel III (NCEP ATP III) criteria[10] modified for waist circumference for Asian Indians (as recommended by WHO for the Asia Pacific region[11]) as the presence of 3 or more of the following risk factors: fasting plasma glucose ≥110 mg/dl (≥6.1 mmol/L), serum triglyceride ≥150 mg/dl (≥1.7 mmol/L), HDL cholesterol <40 mg/dl (≤1.0 mmol/L) in men and <50 mg/dl (≤1.3 mmol/L) in women; blood pressure ≥130/85 mmHg or waist circumference ≥90 cm in men and ≥80 cm in women.

Physical activity was assessed using close-ended questions probing self-perceived, self-reported type (occupational, domestic, leisure time and transport related) during the past 5 years. The intensity of physical activity was classified as 'very light' (walking, job involving desk work, watching television), 'light' (standing all day working, housework such as cooking, cleaning in the house), 'moderate' (gardening, agricultural work, walking long distances up and down hills, climbing more than 20 steps in a day), and 'heavy' (lifting heavy weights, construction work, manual labour and running).

Comparison with the general population

We compared the results of our study with the results of the Chennai Urban Rural Epidemiology Study (CURES), which was done in a representative population of adults ≥20 years of age in Chennai. The detailed study design of CURES is described elsewhere[12] and the sampling frame is available at *http://www.drmohansdiabetes.com/mdrf/CURES.pdf*.

RESULTS

The mean (SD) age of the study population was 39.6 (11.2) years (men: 41.1 [11.0] years and women: 38.2 [11.0] years). Among the study population, 233 men (42.8%) and 180 women (29.2%) were professionals, postgraduates or graduates (Table I). Only 0.4% of men and 1.8% of women were illiterate. Almost half the men (42.9%) were involved in skilled or semi-skilled occupations, followed by clerical jobs 33%; 11.9% were professionals and the rest were either unskilled or unemployed. A majority of women (80.7%) were homemakers. Among men (*n*=545), 22.9% were current tobacco users; of these 21.3% smoked and 2.4% chewed tobacco. Among women (*n*=622) only 1% reported using any form of tobacco. None of the subjects reported the use of snuff. Alcohol consumption was reported only by men and 40 of them (7.8%) consumed alcohol regularly (at least 3 times a week) while 115 were occasional alcohol users (22.4%).

Only 2% of the subjects were involved in heavy physical activities, 19% in moderate physical activity and 79% of the population in either light or very light (sedentary) physical activity.

The major risk factors for CVD age-adjusted using the 2001 Census of India were diabetes 11.9%, hypertension 25.4%, dyslipidaemia 40.2%, hypertriglyceridaemia 28.3%, metabolic syndrome 34.1% and overweight 60.2%. The gender-wise age-adjusted prevalence of risk factors of CVD showed that women had a higher age-adjusted prevalence of overweight, central obesity and metabolic syndrome compared with men (Fig. 1). The age-adjusted prevalence of hypertension, hypertriglyceridaemia and dyslipidaemia was higher in men than in women. The overall prevalence of CVD was 2.1% (men 2.2%, women 2.1%) and the prevalence of stroke was 0.2% in both men and women.

The prevalence of overweight, central obesity, hypertriglyceridaemia, high LDL cholesterol and dyslipidaemia increased with age and either plateaued or decreased in older age groups (>60 years). The prevalence of diabetes, hypertension and metabolic syndrome increased steadily until the age of 60 years and decreased thereafter in both sexes (Table II).

Compared with women, men had significantly higher mean systolic blood pressure (men 127 [16] mmHg, women 120 [19] mmHg), diastolic blood pressure (men 80 [11] mmHg, women 77 [11] mmHg), waist circumference (men 87.9 [10.7] cm, women 84.0 [11.4] cm) and serum triglycerides (men 151 [108] mg/dl, women 121 [89] mg/dl). Women had a significantly higher BMI (men 24.1 [5.4] kg/m^2, women 25.3 [4.7] kg/m^2) and HDL cholesterol (men 39 [9] mg/dl, women 45 [9] mg/dl). There was no difference in the mean levels of fasting plasma glucose, total cholesterol and LDL cholesterol between men and women. The mean systolic blood pressure increased with age in both men and women. The mean diastolic blood pressure, BMI, waist circumference, fasting plasma glucose, cholesterol, triglycerides and LDL cholesterol increased with age till the age of 60 years and either decreased or plateaued thereafter. HDL cholesterol had no linear relationship with age (Table III).

Among those with diabetes (*n*=120), 78% subjects admitted to following the dietary modifications prescribed while 22% did regular physical exercise. A majority of subjects (88.2%) were receiving allopathic drugs (78% oral hypoglycaemic drugs and 10.2% insulin), 19.5% were on traditional treatment and 1.7% were not receiving any treatment for diabetes (some subjects were receiving more than one form of treatment). Among the subjects who had hypertension (*n*=134), 65.2% were on allopathic drugs, 16.7% on traditional treatment and 1.5% were not receiving any treatment (Fig. 2). Among those on medication, 83.9% of subjects with diabetes and 78.8% of those with hypertension were on regular medication. While 74.6% of subjects (*n*=88) with diabetes perceived themselves to be under good glycaemic control, 69.7% (*n*=92) of hypertensive subjects perceived their blood pressure to be under good control. However, the results of the fasting blood glucose and blood pressure measurements showed that of those on medication, only 42.1% of those with diabetes and 55.3% of those with hypertension were under adequate control (i.e. fasting blood glucose <140 mg/dl for diabetic subjects and systolic/diastolic blood pressure <140/90 mmHg for hypertensive subjects).

A comparison of our results with those from the general population of Chennai showed that the prevalence of hypertension, generalized obesity and metabolic syndrome was higher compared with the general population while the prevalence of dyslipidaemia was comparable (Table IV). The awareness and control of hypertension was better among our subjects compared with the general population.

TABLE I. Characteristics of the study population

Variable	Total (*n*=1167)	Men (*n*=545)	Women (*n*=622)
Mean (SD) age (years)	39.6 (11.2)	41.1 (11.0)	38.2 (11.0)
Age group in years (%)			
20–29	19.3	16.8	21.5
30–39	31.6	26.6	36.1
40–49	29.8	31.9	27.9
50–59	15.1	21.4	9.5
≥60	4.2	3.3	5.1
Total	100	46.7	53.3
Education (%)			
Professional/postgraduate/graduate	35.5	42.8	29.2
Secondary school	60.2	55.2	64.7
Up to primary/literate	3.1	1.7	4.4
Illiterate	1.1	0.4	1.8
Occupation (%)			
Professional	6.6	11.9	1.9
Trained/clerical	20.4	33.0	9.2
Skilled/semi-skilled	20.7	42.9	1.1
Unskilled	0.3	0.7	0
Unemployed	9.0	11.4	7.0
Housewife	42.9	0	80.7
Tobacco use (%)			
Ever used	16.7	35.0	0.5
Current use*	11.0	22.9	0.5
Current smoking	10.0	21.3	0
Current chewing	1.4	2.4	0.5
Alcohol (%)			
Never used	86.3	69.8	100
Current regular use†	3.5	7.8	0
Current occasional use‡	10.2	22.4	0
Physical activity (%)			
Very light	3.9	4.2	3.6
Light	75.2	73.5	76.7
Moderate	19.0	19.3	18.7
Heavy	1.9	2.9	1.0
Self-reported diabetes (%)	10.3	12.1	8.7
Self-reported hypertension (%)	11.5	13.0	10.1

* use of tobacco products in any form in previous 30 days † alcohol intake more than 3 times (average) a week ‡ alcohol intake more than 3 times a month, but less than 3 times a week

DISCUSSION

We studied the prevalence of risk factors for CVD in an industrial

TABLE II. Prevalence of overweight, central obesity, dyslipidaemia, diabetes, hypertension and metabolic syndrome in different age groups

Variable	20–29 years		30–39 years		40–49 years		50–59 years		≥60 years		Total	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Body mass index												
≥ 23 kg/m^2	29 (33.0)	58 (47.2)	96 (67.6)	163 (75.1)	113 (66.9)	122 (75.3)	75 (66.4)	47 (81.0)	7 (41.2)	20 (69.0)	320 (60.5)	410 (69.6)
≥ 25 kg/m^2	16 (17.8)	32 (26.0)	56 (40.0)	121 (56.0)	67 (39.4)	99 (60.7)	51 (44.7)	36 (62.1)	4 (22.2)	18 (62.1)	194 (36.5)	306 (52.0)
Central obesity*	14 (15.6)	28 (22.4)	61 (43.0)	116 (53.0)	92 (53.8)	89 (54.6)	64 (55.7)	33 (56.9)	7 (38.9)	19 (65.5)	238 (44.4)	285 (47.9)
TC/HDL ≥4.5†	20 (33.9)	13 (17.8)	49 (53.8)	40 (27.8)	65 (63.1)	32 (34.8)	34 (50.7)	11 (37.9)	5 (62.5)	6 (37.5)	173 (52.7)	102 (28.8)
Triglycerides ≥ 150 mg/dl	13 (22.0)	4 (5.5)	41 (45.1)	28 (19.4)	42 (40.8)	25 (27.2)	22 (32.8)	12 (41.4)	3 (37.5)	9 (56.3)	121 (36.9)	78 (22.0)
LDL cholesterol ≥ 130 mg/dl	12 (20.3)	9 (12.3)	14 (15.4)	26 (17.9)	31 (29.8)	23 (25.0)	20 (30.3)	14 (48.3)	5 (62.5)	4 (26.7)	82 (25.0)	76 (21.5)
Diabetes‡	1 (1.1)	2 (1.5)	12 (8.2)	14 (6.3)	31 (17.9)	28 (16.4)	33 (28.4)	20 (33.3)	4 (22.2)	8 (25.8)	81 (14.9)	72 (11.6)
Hypertension§	11 (12.0)	4 (3.0)	37 (25.3)	21 (9.4)	58 (33.5)	62 (36.3)	67 (57.8)	32 (53.3)	6 (33.3)	19 (61.3)	179 (32.8)	138 (22.3)
Metabolic syndrome‖	8 (13.6)	5 (6.8)	32 (35.2)	38 (26.8)	44 (43.1)	45 (48.9)	31 (47.0)	22 (78.6)	4 (50.0)	12 (75.0)	119 (36.5)	122 (34.8)

* waist circumference >90 cm in men and >85 cm in women †TC/HDL total cholesterol to high-density lipoprotein cholesterol ratio ‡ fasting plasma glucose ≥126 mg/dl or drug treatment for diabetes mellitus § systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg or under medication for hypertension ‖ based on NCEP ATP III criteria: NCEP ATP III guidelines define metabolic syndrome based on presence of any three of the following five components: abdominal obesity, elevated triglycerides, low HDL cholesterol, raised blood pressure and impaired fasting glucose level Values in parentheses are percentages

TABLE III. Age-specific blood pressure, body mass index, waist circumference and lipid levels in our study population

Variable	20–29 years		30–39 years		40–49 years		50–59 years		≥60 years		Total	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Blood pressure (mmHg)												
Systolic	123 (11)	110 (10)	125 (13)	115 (14)	126 (17)	126 (20)	132 (20)	135 (25)	134 (16)	143 (20)	127 (16)	120 (19)
Diastolic	74 (8)	71 (8)	80 (11)	76 (10)	81 (11)	81 (11)	84 (12)	82 (10)	78 (7)	82 (11)	80 (11)	77 (11)
Body mass index (kg/m^2)	21.5 (3.9)	22.7 (4.4)	24.5 (3.0)	25.8 (4.5)	25 (8.1)	26 (4.7)	24.6 (3.1)	26.1 (4.1)	22.9 (3.0)	27.2 (5.3)	24.1 (5.4)	25.3 (4.7)
Waist circumference (cm)	78.5 (11.2)	77.5 (11.4)	88.7 (8.5)	85.0 (10.4)	90 (10.4)	85.8 (10.4)	91.2 (9.7)	86.9 (11.4)	86.6 (7.8)	89.4 (12.8)	87.9 (10.7)	84.0 (11.4)
Fasting plasma glucose (mg/dl)	84 (8)	88 (9)	94 (17)	96 (30)	108 (44)	109 (40)	117 (42)	135 (67)	96 (15)	120 (39)	101 (35)	102 (37)
Cholesterol (mg/dl)	166 (36)	162 (27)	177 (32)	171 (31)	186 (41)	189 (38)	184 (40)	197 (30)	183 (46)	194 (35)	179 (38)	177 (34)
Triglycerides (mg/dl)	108 (57)	83 (36)	167 (109)	112 (62)	158 (97)	138 (73)	155 (144)	140 (56)	138 (90)	238 (288)	151 (108)	121 (89)
HDL cholesterol (mg/dl)	42 (9)	47 (9)	38 (9)	44 (9)	38 (8)	46 (10)	40 (10)	46 (9)	38 (9)	43 (7)	39 (9)	45 (9)
LDL cholesterol (mg/dl)	102 (30)	99 (25)	105 (27)	105 (27)	116 (36)	116 (33)	116 (36)	123 (25)	117 (35)	110 (33)	111 (33)	108 (30)

HDL high-density lipoprotein LDL low-density lipoprotein All values are mean (SD)

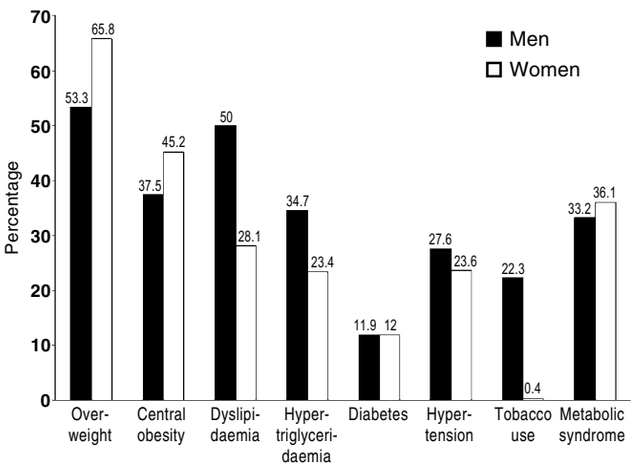

FIG 1. Age-adjusted prevalence of risk factors for cardiovascular disease in an industrial population

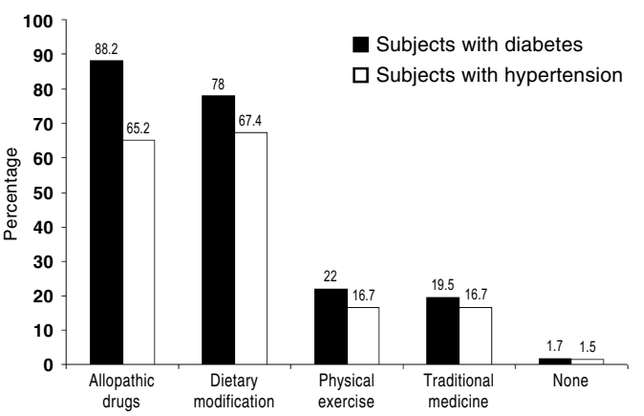

FIG 2. Type of treatment taken by subjects with diabetes and hypertension

TABLE IV. Comparison of percentage prevalence of cardiovascular risk factors in this study and in the general population (CURES study)

Cardiovascular risk factors	Present study (*n*=1167)	General population (CURES) (*n*=2350)
Diabetes	11.9	14.3
Hypertension	25.4	20
Awareness	42.3	32.8
Treatment	66.7	70.8
Control	55.2	45.9
Generalized obesity	44.5	28.1
Abdominal obesity	42.1	49.2
Dyslipidaemia	40.2	41
Metabolic syndrome	34.1	18.3

population of Chennai. Our study presents the 'best case scenario' because the industries offer free healthcare to their employees. The study assumes importance as it answers the question: 'What would be the state of risk factors for CVD and the status of treatment of diabetes and hypertension in India if there were no financial constraints to healthcare?' As most healthcare expenditure in India (>80%) is 'out of pocket', optimal healthcare is not accessible to a large population in India. The argument therefore is that if there were no financial constraints, healthcare would be optimum. The key findings of our study are that in this industrial population the prevalence of most risk factors for CVD is high and the number of people engaged in physical activity is very low. Among those with known diabetes and hypertension on treatment, 80% were reported to be on regular medication.

Asian Indians develop diabetes a decade earlier than Europeans[2] with the most marked increase in prevalence being among those in the productive age group. In a large epidemiological study done on a representative population of Chennai (CURES), it was seen that >10% of individuals in the age group of 30–39 years and 20% of individuals in the age group of 40–49 years had diabetes.[13] The Indian Council of Medical Research (ICMR) Sentinel Surveillance Systems for CVD in Indian industrial populations, involving 10 centres from different parts of India, documented a 10.1% overall prevalence of diabetes in the age group of 20–69 years.[14] In our study, which is also part of the study mentioned above, the age-standardized prevalence of diabetes (11.9%) was slightly higher than that reported in other studies. Also, the high prevalence of self-reported diabetes (10.3%) in our study shows the high level of health awareness of this industrial population and the excellent healthcare facilities available to them. Differences in access to healthcare can have far-reaching consequences. In addition, several other factors influence the health of a population including socioeconomic status, urbanization and lifestyle changes. Though healthcare facilities are overwhelmingly concentrated in urban areas, the 'socioeconomic distance' prevents access to these for the urban poor. One of our earlier studies showed that significant differences exist in the prevalence of various components of the metabolic syndrome even within an urban environment and this appears to be influenced by the socioeconomic status.[15]

The age-adjusted prevalence of hypertension (25.4%) in our study was similar to that seen at the other 10 centres in India in the ICMR sentinel surveillance project (26%).[14] The prevalence of hypertension in this industrial population was also higher than that reported in population-based studies in Chennai (the Chennai Urban Population Study 21.1%[16] and CURES 20%[17]). In CURES, among subjects with hypertension, 32.8% were aware of their condition; of these, 70.8% were under treatment and 45.9% had their blood pressure under control.[17] Thus, compared with the general population of Chennai, this industrial population was more aware of hypertension and control of blood pressure. However, this may be because this population was more affluent than the general population of Chennai.

In our study, the age-adjusted prevalence of overweight (BMI $\geq$23 kg/m^2) was 60.2%. The age-adjusted prevalence of overweight (BMI $\geq$23 kg/m^2) among the industrial population in the ICMR sentinel surveillance project of 10 Indian industrial centres was 46.7%.[14] As reported in the sentinel project, the overall prevalence of overweight (BMI $\geq$25 kg/m^2) was lowest in Assam (0.5%) and highest in Hyderabad (50%). Among the industrial populations of Bangalore, Trivandrum and Coimbatore, the prevalence rates of overweight (BMI $\geq$25 kg/m^2) were 47%, 38% and 27%, respectively.[18] The overall prevalence of overweight (BMI $\geq$25 kg/m^2) in our study was 44.5%. The sedentary job profile of the subjects may be the reason for the high rates of overweight in this population.

Central or abdominal obesity was present in 32% of the industrial population in the ICMR sentinel surveillance project among all 10 centres and the highest prevalence was reported from Hyderabad (52%). The population of Bangalore, Trivandrum and Coimbatore had prevalence rates of 45%, 32% and 41%, respectively.[18] In our study, the prevalence of central obesity was 42.1% while in the CURES study it was 49.2% in the urban population of Chennai.[19]

The ICMR sentinel surveillance project observed the prevalence of dyslipidaemia to be 37.5% in individuals in the age group of 15–64 years and 62% among individuals in the age group of 20–59 years.[14] In our study, dyslipidaemia was present in 40.2% of those in the age group of 20–69 years.

The age-adjusted prevalence of metabolic syndrome in this study was 34.1%, which is higher than that reported by the ICMR sentinel surveillance project (24.8%).[14] In CURES, the prevalence of metabolic syndrome was 23.2% by the WHO criteria, 18.3% by the ATP III criteria and 25.8% by the International Diabetes Federation criteria,[20] which were all less than that in our study. The reason for this higher prevalence may be the sedentary lifestyle of the subjects.

Based on the subjects' perceived daily physical activity, the physical activity levels were generally low in our study, with 79% of subjects involved in very light or light physical activity. In the ICMR sentinel surveillance project, 13%, 51.4% and 35.6% of the industrial population were involved in heavy, moderate and light physical activity.[14] This suggests the need for increasing awareness about the benefits of physical activity.

The National Household Survey of Drug and Alcohol Abuse in India (NHSDAA) on 40 000 men in 25 states documented the overall prevalence of current tobacco use to be 54.9% in those in the age group of 19–30 years, 67.6% among 31–40 years and 72% among those 41–60 years.[21] The prevalence of tobacco use among individuals $\geq$15 years of age according to the National Sample Survey (NSS) was 51.3% in men and 10.3% in women and, based on the National Family Health Survey-2 (NFHS-2), it was 46.5% in men and 13.8% in women.[21] In the ICMR sentinel surveillance project, the prevalence of current tobacco use was 40.2% among men and 14.9% among women.[14] In our study, 22.9% of men and 0.5% of women were current tobacco users; these figures are comparatively lower than those reported earlier.

A range of factors contribute to the increasing trend in risk factors for CVD. Compared with other countries, India has the

highest loss in potentially productive years of life due to deaths from CVD in people 35–64 years of age.[6] The higher rates of risk factors for CVD in this relatively young population from southern India is alarming and preventive measures need to be initiated. It also suggests that though healthcare is better in this industrial population compared with the general population, it is still inadequate. It underscores the need for increasing awareness of non-communicable diseases even in populations that have access to free healthcare. The inaccessibility of healthcare facilities has affected the utilization of modern healthcare services by a majority of people in India. However, the results of this study highlight that in addition to accessibility, there are factors such as health awareness and involvement in physical activity which play a major role in combating CVD and thereby improve the quality of life.

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