PREVALENCE OF RISK FACTORS FOR CARDIOVASCULAR DISEASE AMONG INDUSTRIAL WORKERS, IN CHENNAI CITY

By

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CERTIFICATION

This is to certify that this dissertation entitled **"Prevalence of risk factors for cardiovascular disease among industrial workers in Chennai City"**, submitted by **Dr. Sawan S. Solanki** in partial fulfillment of the requirements for the degree of Master of Applied Epidemiology is the original work done by him / her and has not been submitted earlier in part or whole for any other (Publication or degree) purpose.

DIRECTOR

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Abstract

Background:

The second, half of the 20th century has witnessed a global spread of Coronary Artery Disease (CAD) epidemic especially in developing countries, including India. The Framingham Heart Study, USA, played a vital role in defining the risk factors for CHD incidence in general population. Major conventional risk factors include: sedentary life style, cigarette smoking, hypertension, high LDL cholesterol, low HDL cholesterol and diabetes mellitus.

Objectives:

(i) To estimate the prevalence of risk factors for CVD among industrial workers in Chennai City.

(ii) To suggest appropriate intervention measures to reduce/ prevent risk factors of high prevalence identified in (i).

Methods:

A cross- sectional survey was conducted on a random sample of 200, workers of an industrial unit in Chennai City. They were interviewed for the prevalence of risk factors using the WHO step-wise concept. The semi structured questionnaire included socio-demographic variables eg. age, sex, occupation, family size, income and education; behavioral risk factors eg smoking, alcohol, physical inactivity and nutrition. In addition, anthropometrical measurements eg height, weight, BMI and biochemical measurements eg. fasting blood sugar and lipid profile were assessed.

Results:

The prevalence of hypertension, diabetes mellitus and metabolic syndrome in the study population was 29%, 4.3% and 7.6% respectively. As per the BMI status of the study subjects 43.2% and 19.4 % were found to have increased risk and high risk respectively for CVD as per WHO cut off levels for Asians. Prevalence of tobacco and alcohol consumption was found to be 40.5% and 44% respectively.

Conclusions:

Based on the results of this study the following conclusions were arrived at: (1). High prevalence of modifiable risk factors such as smoking, alcohol, consumption and BMI in high risk range were observed in this study, (2). Clustering of hypertension, central obesity, dyslipidemia and diabetes was observed in one third of the study population

Recommendations:

For feasibility reasons t he sample size of this study was 200 industrial workers. It is recommended that similar studies be conducted on larger samples to reconfirm the findings observe in this study. Furthermore since the prevalence of risk factors – hypertension, diabetes, metabolic syndrome, tobacco and alcohol consumptions BMI, are high in this study population, it is suggested that planned IEC activities be initiated for them to bring about a favorable shift in the prevalence of these risk factors.

I - INTRODUCTION

The second, half of the 20 th Century has witnessed a global spread of the Coronary Artery Disease (CAD) epidemic especially in developing countries, including India. The Framingham Heart study, USA, played a vital role in defining the risk factors for CHD incidence in general population. Major conventional risk factors are sedentary life style, cigarette smoking, hypertension, high LDL cholesterol, low HDL cholesterol and diabetes.

Several factors appear likely to have contributed to the acceleration of CAD epidemic in India in recent times. These are: (i). Increases in population aged 60 and above years as a result of increasing life expectancy. (ii). Confluence of both conventional risk factors and non-conventional risk factors in Indians. Conventional risk factors owe their origin to growing urbanization and western 'acculturation' amongst Indians. Non-conventional risk factors like hyperinsulinaemia, insulin resistance, lipoprotein 'a' etc, are determined by genes on other 'programming' factors and their high prevalence amongst Indians probably explain the malignant precocious nature of CAD that typically affects Indians. These multiplicative effects of conventional and emerging risk factors appear to provide a plausible explanation for the excess burden of CAD among Indians.

In India, the lack of facilities for diagnosis and treatment, as well as high cost of medical care add to the existing heavy burden of heart disease. Therefore a concerted public health response must integrate population-based prevention strategies and cost-effective clinical care since health systems of developing countries can ill afford the demands of technology-intensive treatment.

The population approach is more rewarding and sustainable in the medium and long term, since even small reductions in the rate of cardiovascular events, and if healthy behavior is established as a desirable norm in a society, can have multigenerational effects.

The raise and recent decline of CVD epidemic in the developed countries have been well documented[1-4-7]. The identification of major risk factors through population based studies and effective control strategies combining community education and targeted management of high risk individuals have together contributed to the fall in CVD mortality rates, that has been observed in almost all industrialized countries. It has been estimated that, during the period 1965-90 CVD related mortality fell by 50% approximately in Australia, Canada, France and the United States, and by 60% in Japan [2]. Other parts of Western Europe reported more modest declines viz., 20-25%.

The excess risk of CAD in Indians appears to be greater at younger ages when people move from a rural to an urban environment, they become sedentary or may adapt westerns life styles. Decreased physical activity and increased consumption of calories and saturated fats result in abdominal obesity, insulin resistance and atherogenic dyslipidaemia. These acquired metabolic abnormalities appear to have a synergistic effect on the development of CAD in genetically predisposed individuals.

To prevent and/or reduce the risk of morbidity and mortality due to CVD, it is essential to understand the magnitude of the problem of CVD as well as the nature and prevalence of risk factors that possibly contribute to it. Very few population based studies have been conducted in different parts of India to assess the prevalence of CVD.

In the context of demographic and epidemiological transition as well as changing life styles of people, there is an urgent need to systematically document baseline information on the prevalence of risk factors possibly contributing to the problem of CVD in different population groups in India. This will enable us apply locally and with necessary modifications, the vast knowledge and experience gained on the problem of CVD from the developed counties. The present study to "Estimate the prevalence of risk factors for CVD among workers in an industrial unit in Chennai City" is one such a humble effort.

Coronary artery disease is the commonest form of heart disease, above the age of 40 years. CVD are major contributors of morbidity and mortality in India. Deaths from coronary heart disease in India rose from 1.17 million in 1990 to 1.59 million in 2000 and are expected to further rise to 2.03 million in 2010. An urban prevalence of 10% is a credible estimate based on several surveys [WHO Health SEA]. India has nearly 25 million cases of Ischemic heart disease [WHO NCD SEA].

Global disease burden:

Cardio vascular disease (CVD) has become an ubiquitous cause of morbidity leading to mortality in most countries [1,2]. The rise and recent decline of the CVD epidemic in developed countries has been well documented.[3,4]. During the period 1965 to 1990, CVD related mortality fell by 50% in Australia, Canada, France and The United States and by 60% in Japan [1]. Western Europe reported more moderate declines (20% to 25%). The discordant trend of rising CVD mortality rates in Eastern Europe, however, is in sharp contrast to the decline in Western Europe

There is a growing epidemic of cardiovascular diseases causing 30.9% of mortality [7]. Of the total 14 million deaths due to cardiovascular diseases globally, 78% occurred in the developing countries [8]. CVD related morbidity in the developing countries account for 86% in the world [7]. The Disability Adjusted Life Years (DALY) of the developing world due to CVD is 2.8 times that of the developed world. [8].

Indian scenario:

Cardiovascular disease burden is hard to assess in India, in the absence of cause specific mortality data due to inadequate and inappropriate documentation of death. WHO estimate that in 1990, there were 2.4 million deaths due to CVD (-0.78 million due to coronary diseases and 0.68 due to cardiovascular disease [9]). India accounts for 17% of the global CVD mortality [8]. Based on projected demographic trends, it is expected that CVD would emerge as the single largest contributor to mortality in India by 2015[10].

In 1962 in a study reported from Delhi, the prevalence of CVD was reported to be 5.5% in high–income group and 0.33% in low income groups[11]. In 1990, using history and ECG criteria, prevalence of Ischemic Heart Disease (IHD) was 9.67% in the 35-64 age group [12]. A study in urban Delhi and rural Haryana in 1993, based on history, showed a prevalence of 4.4% in urban region and 0.5% in rural region between the ages of 35 and 64 years [13]. Another study, using ECG and history criteria in a population aged above 20 years in rural and urban Rajasthan showed a prevalence of 3.5 and 6.0% in men and 3.5 and 10.5% in women respectively [14].

The reasons behind the rise of coronary heart disease in India are believed to be multifactorial, including genetic predisposition, Increased calorie and fat intake, low physical activity, weight gain, smoking, stress and sedimentary life style.

Risk Factors:

The development of CVD is linked to risk factors that may be classified as indicated below [15]: The etiology of CVD is multifactorial. Risk factors can be divided into two categories.

Table. 1. Modifiable and Non Modifiable Risk Factors for CVD

Non modifiable	Modifiable
Age	Cigarette smoking
Sex	High blood pressure
Genetic factors	Elevated serum cholesterol
Family history	Diabetes
	Obesity
	Sedentary habits
	Stress

Most of the modifiable risk factors and strategies for prevention of CVD are similar for males and females. However, the magnitude of the effect of some risk factors differs between male and female. There are some risk factors, as well as preventive interventions, that are unique to females, such as use of oral contraceptives, number of pregnancies, menopause and hormonal status.

Non-Modifiable Risk-Factors:

Age:

Incidence of coronary artery disease and acute myocardial infarction increases as the age increases. Approximately 80% of fatal myocardial infarctions is in patients 65 years. It is difficult to determine, whether aging itself acts as a pathogenic mechanism or as it seems likely, that age increases the impact of other risk factors.

Framingham heart study established seven times more morbidity in third decade of life in males as compared to females, decreasing progressively to equity in the seventh decade. The results showed that the morbidity was 8% for males and 1.3% for females

in 30-44 years age group and 18% for males and 13% for females aged between 55-62 years.

The reasons for delayed onset of coronary heart disease in females, compared to males are still unclear though ovarian function may be partly responsible for the above observation and there is definite interlinking between other risk factors.

Gender:

In the Framingham heart study, 26 years follow up of men and women aged 35 to 84 years indicated that coronary artery disease morbidity was twice as high in men compared women with 60% of coronary events occurring in men. Women have the same modifiable risk factors as men, although diabetes appears to confer greater risk in females than males, as may low HDL cholesterol and elevated plasma triglycerides. Though the male sex is considered as a risk factor, for CVD, females are not immune Choudary et al (1999) reported that at young age this is predominantly a disease of men. It is evident by various reports that the incidence of coronary artery disease in females is low all over the world. But the incidence of coronary artery disease increases with menopause and oophrectomy (surgical menopause) suggesting that it is likely that female sex hormones might have got a protective action.

Genetic susceptibility and family history:

Comparative study of migrant Indians with other ethnic groups in several countries have helped study different genetic pools in the same environment [8] Reddy 1998) South Asians have higher coronary mortality than other ethnic groups in UK, Trinidad Fiji, South Africa and Singapore. [18,19].

Premature coronary artery disease often appears to be familial in many instances, and can be attributed to the inheritance of risk factors such as hypertension, diabetes mellitus, hyperlipidemia.

Study conducted by Pohloza Sintoness et al (1998) shows that for sisters of the females patients the cumulative risk of CVD by the age of 65 was almost double that of sisters of male patients and the risk for the brothers of the females did not significantly differ from that of mothers of male patients.

Coronary atherosclerosis tends to aggregate in families. In studies that controlled other risk factors, family history of coronary artery disease has been shown to be a strong independent risk factor for coronary artery disease. Risk for myocardial infarction was inversely related to age at which myocardial infarction occurred in patient.

Increased coronary artery disease risk associated with a positive family history may be mediated by genetic effects on other risk factors such as obesity, hypertension, dyslipidemias and diabetes mellitus. [20]. In a study of CHD in urban and rural populations in and around Delhi family history was reported to be 20.5% in urban and 1.7% in rural women[20].

Modifiable risk factors:

Smoking:

It is a major cause of preventable morbidity for CVD and one of the most modifiable risk factor. Cigarette smoking causes more death from CVD than from lung Cancer [21]. In Framingham study, smoking 10 cigarettes/day increased CVD mortality by 18% in

men and 31% in women. Kannel (1990) and Sharma (1992) reported hypertension as a more common (60.8%) risk factor than smoking.

Passive smoking was also reported to increase the relative risk of CVD mortality by 1.7 [23]. WHO estimates that 35% of all CVD mortality in developing country is due to smoking [21]. In India, in a risk factor study from Rajasthan, tobacco use was associated with a Relative Risk (RR) of 1.49 (95% CI 1-2.45) for IHD [14]. Cessation of tobacco consumption has been shown to decrease the risk of CVD mortality [14,24].

Dyslipidemia

The most common dyslipidemia in both males and females was low HDL-cholesterol (<40 mg/dl: males 54.9%, females 54.2%). High total cholesterol levels of > or =200 mg/dl (males 37.4%, females 4.1%), high LDL-cholesterol levels of > or =130 mg/dl (males 37.0%, females 45.8%) and high levels of triglycerides > or = 150 mg/dl (males 32.3%, females 28.6%) were also seen in a significant number. Hypertension, obesity, truncal obesity, diabetes and dyslipidemias increased significantly with age in both males and females (Mantel-Haenzel chi2 for trend, $p<0.05$)[25].

In a study conducted by Gupta et al (2002), on an urban Indian population a high prevalence of standard coronary risk factors-smoking, physical inactivity, hypertension, hypercholesterolemia, diabetes and obesity--as well as factors peculiar to south Asians--truncal obesity, low HDL-cholesterol and high triglycerides was observed. Total cholesterol, low density Lipoproteins (LDL) are risk factors for CVD [26]. Cholesterol lowering therapy has also been shown to decrease the risk of coronary events in primary and secondary prevention trials. Studies of migrant Indians have shown

cholesterol levels to be more or less same or higher [27,28,29]. HDL Cholesterol level are also variable in-migrant Indians [27,29]. In India, hypercholesterlemia (>200 mg%) and HDL (<35 mg%)is similarly prevalent in urban and in rural population [14] though CHD prevalence was more in urban population.

Hypertension:

The Framingham heart study (1977) suggested that hypertension has almost a linear relationship with CAD. An exploratory study was carried out in 32 hypertensive patients seen at 2 health care units in the municipal district of Ribeiro Preto, Brazil with the objective of knowing arterial hypertensive patients through their attitudes, beliefs, perceptions, thoughts and practices related to the disease. Subjects were interviewed in a single session and data were analyzed using Content Analysis method through categories not defined a priori.

Hypertension is major risk factor for CVD. In India, the RR for CAD due to Hypertension was 2.9 [31]. In a study conducted in urban and rural Rajasthan[14], the prevalence of hypertension in men was 29.5% and 23.5% respectively and in women, it was 3.5% and 16.7% respectively.

A community based survey (1990)[32] for the prevalence of hypertension was carried out on a random urban sample of 13,723 adults in the age group 25-64 years in Delhi. Hypertension was defined as systolic pressure greater than 160 mmHg and/or diastolic pressure greater than 90 mmHg or a history of current anti hypertensive medication. The overall prevalence of hypertension was 127.5/1000 of which men had a prevalence rate of 116.6/1000 and women had a prevalence of 136.8/1000. The prevalence rate

was higher in females except in age group 25-34 years. The prevalence rate increased with age in both sexes.

Those who were aware of their hypertensive status or known cases were 49.5%, of which the awareness was slightly higher in women (51.8%) than in men (46.4%). The 'awareness' of hypertension showed an increasing trend with age in both sexes. Severity of hypertension showed an association with age, in both sexes and moderate and severe grades of hypertension increasing with age in both sexes. The awareness of hypertension increased with severity. Out of the known case, 20.1% had not received any treatment or had discontinued after initial medication. The percentage of men and women who fell in this category were 19.1% and 20.9% respectively. Approximately 30% of hypertensives were on medication. The proportion of hypertensives on medication in both sexes showed an increase with age. In women, the proportion of patients not taking medication decreased with age, though such trend was not apparent in men. A small percentage of all hypertensives (8.9%) had control of their blood pressure with little difference in sexes or age group[32].

Overall, the study emphasizes the enormity of the problem of hypertension in an urban population in India as well as poor control of blood pressure achieved in the community.

Anand et al, (2001)[34] reported a prevalence of 26.8% in men and 27.65% in women in the age group 28-65 years, using the criteria $\geq$140/90. Diagnosis of hypertension was based on the average of three readings on the 2nd occasion after initial screening.

A survey conducted among the tea workers of Assam by [35] on the prevalence of hypertension and its risk factors reports an overall, high prevalence of 60.8%. The disease burden of hypertension among workers in tea gardens is large, despite the community not being obese. Interventions directed at these workers as well as studies to determine the reasons for the high prevalence of hypertension are required. [35]

Diabetes mellitus:

Cardio vascular diseases are more common among diabetics (Ostrader et al 1965). Atherosclerotic changes in coronary vessels are four times more frequent among diabetes than among non-diabetics Forsham et al (1958) and Dwivedi (1999)[33] reported diabetes in 12.1% cases in Delhi series (urban) and 1.5% of cases in Rohtak series (rural).

Banerjee et al (1966) noted electrocardiographic abnormalities in 30% cases with diabetes, 12% of these gave history of cardiac pain, while 18% did not give any such history. Wadia et al (1973) reported diabetes in 14.3% of younger patients and in 25% of older patient. Lechstin et al (1974) reported in study of 531 coronary artery disease cases, the incidence of diabetes as 16%.

Datey et al (1978) reported incidence of coronary artery disease 2 to 3 times higher in diabetic men and 5 to 6 times higher in diabetic women as compared to non-diabetics in both males and females.

Kaul (1986) reported that 5% of obstructive coronary artery disease cases were diabetic. Gupta et al [25] suggest that diabetes is a significant factor in the develop of cardio vascular disease.

The convergence of type 2 Diabetes mellitus, Insulin resistance, glucose intolerance, hypertension, obesity and dyslipidemia is known as syndrome X (Hansen1999). South Asians have a greater risk of developing Type 2 Diabetes mellitus (Mckeigue 1997). The cases of Myocardial Infarction in India are more likely to have diabetes (0R-5.49) or Glucose intolerance (OR-4.8) than age or gender matched controls [31] In subject greater than 40 years old, the incidence of Hyperinsulinemia is 55.1% in an urban population.

Dwivedi et al [33] reported diabetes in 12.1% cases, and hypertension in 57.6% cases in Delhi series (urban), whereas for the Rohtak series (rural) the figures were1.5% and 10.7% respectively[25].

In a study conducted by Mohan et al (2001), the prevalence of diabetes was 12%. An additional 5.9% of the subjects had impaired glucose tolerance [38]. One out of every six individuals in urban Chennai above 20 years has either diabetes or impaired glucose intolerance. In a similar population-based study conducted in 6 urban areas in India, the overall prevalence of diabetes was 12.1 %[39]. In the Chennai Urban Population Study (CUPS), 21.4% of the diabetic subjects had CAD compared to 9.1% of subjects with normal glucose.

Predisposing Risk factors:

The relationship between these risk factors and CHD remains complex. They may intensify one of the causal risk factor, alter conditional risk factors like Lipoprotein-(a), Homocysteine or mediate through unknown mechanisms [15].

Obesity:

It may raise the risk of CVD through increased likelihood of Insulin resistance and Diabetes Mellitus. The estimate of Obesity is as low as 3.5% but in cross sectional

studies BMI > 25 g/m2 was found in 27.5% of population (Gopinath 1994). Indians are more likely to have increased abdominal fat which correlates with obesity (Vaz 1999) In a case control trial, waist hip ratio (0.92) was reported as the highest (OR 3.12) predictor of CAD [31].

The overall prevalence of central obesity among the urban women of India has increased, more so in Calcutta and Trivandrum. Body mass index, sedentary lifestyle, and family history of excess intake of fat were significant risk factors for central obesity. [40]

High prevalence of obesity, truncal obesity, hypertension and hypercholesterolaemia in Indian physicians while smoking, low HDL cholesterol and hypertriglyceridemia is low. The overall coronary risk is lower among Indian physicians as compared to previous Indian population studies.[41]. Urbanization increases the risk of hyperglycemia and hypertension independent of the percentage of body fat or its central distribution (Lubree H.G. 2002).

Physical Inactivity:

The protective effect of physical activity may be through better blood pressure control, improved lipid profile, better insulin sensitivity, glucose control and reduced thrombogenesis. Risk of CVD is reported to increase with physical inactivity (RR 1.5-2.4) [42].

Socio-economic class:

When cardio vascular disease emerged as the modern epidemic it was a disease of higher social classes in the most affluent societies; fifty years later the situation is changing giving rise to a strong inverse relation between social class and CVD in developed countries. Although Coronary artery disease is said to be a disease of higher

socio-economic class people with a sedentary life style, it is not uncommon to find quite a good number of cases from lower socio-economic status and marked physically active lifestyles. This is especially true for younger age group patients.

Jhatakia et al (1967), in their study of coronary artery disease patients, reported that 34% of cases belonged to higher income group, 28% to lower income group and rest to middle socio-economic class.

(Wadia et al 1973) in there comparative study of young (90 patient) and old patient (137 patient) reported that there was not any significant difference in higher income group and middle and lower income group patients. Especially among the younger patients he reported that 46 out of 90 patients belonged to higher income group, where as remaining patients belonged to middle and lower income groups. Among the older patients 75 out of 173 belonged to higher income group and 98 belonged to middle and lower income groups.

The relationship between socioeconomic status and CVD is complex and study results have been variable. A study from North India in 1968 indicated that prevalence rose with higher socioeconomic status (Sarvotham1968). A more recent study also showed a similar higher prevalence of CHD among higher socioeconomic group (Chadha 1990)[12]. But individuals belonging to the lower socioeconomic group may have higher prevalence of certain risk factors like smoking (Gupta 1994).

Stress:

Psychosocial factors may contribute to the development o coronary artery disease. The evidence for CAD risk is linked to five psychosocial domains including depression, anxiety, personality traits, social isolation and chronic life stress [44]. In a study from Finland with 25 years of follow up, high job strain was associated with higher

cardiovascular mortality risk (hazard ratio-2.2, Cl 1.2-4.2) [45] The relationship of stress and CVD is poorly studied in India.

From the above delibewrations it is clearly evident that the prevalence of risk factors for coronary heart disease has been inadequately studied in India. A repeat cross-sectional survey was carried out to evaluate the changes in the major coronary risk factors in the urban population of Jaipur previously studied in the early 1990s.

Randomly selected adults > or =20 years of age were studied using stratified sampling. The target study sample was 1800 with a population proportionate gender distribution (males 960, females 840). Coronary risk factors, anthropometric variables, blood pressure, ECG, fasting blood glucose and lipids were evaluated. A total of 1123 subjects (62.4%) (males 550, females 573) were examined. Fasting blood samples were available in 523 males and 559 females. Overall, coronary heart diesase prevalence, diagnosed by history or ECG changes, was found in 34 males (6.18%) and 58 females (10.12%). Risk factor prevalence showed that smoking/tobacco use was present in 201 males (36.5%) and 67 females (11.7%). Physical inactivity, either work-related or leisure time, was seen in 157 males (28.5%) and 130 females (22.7%). Hypertension (> or =140 and/or 90 mmHg) was present in 200 males (36.4%) and 215 females (37.5%). Diabetes diagnosed by history or fasting glucose > or =126 mg/dl was found in 72 males (13.1%) and 65 females (11.3%). Obesity, body mass index > or =27 kg/m2 was present in 135 males (24.5%) and 173 females (30.2%), while truncal obesity (waist: hip >0.9 males, >0.8 females) was found in 316 males (57.4%) and 392 females (68.4%).

III - OBJECTIVES

The objectives of this study are:

1. To estimate the prevalence of risk factors for cardiovascular disease among workers in an industrial unit in Chennai city.
2. To suggest measures to prevent and / or reduce risk factors identified in (1).

IV - HYPOTHESES

Based on the profile of the study population i.e. industrial workers of an urban metropolitan city-Chennai City, the following hypothesis are proposed:

(1) The prevalence of modifiable risk factors such as smoking, alcohol consumption and BMI are likely to be high.

(2) A clustering of hypertension, central obesity, dyslipidemia and diabetes mellitus is likely to occur.

V - METHODS

Study Design:

A cross sectional survey was conducted on 200 randomly selected workers of an industrial unit in Chennai City between August and October, 2004.

Study population:

The study was carried out in an Industrial unit in Chennai City. This Industrial unit manufactures automobile brake components and spares for a wide range of car manufacturing companies in India and abroad.

Study area:

An industrial unit employing 1200 workers with different grades of occupation and equipped with adequate medical facilities was selected for study purposes. For purposes of maintaining confidentiality the industrial unit will be named as X.

Study sample:

A simple random sample of 200 workers was selected for estimating the prevalence of risk factors using the WHO step wise concept for CVD.

Data Collection:

The WHO framework to study prevalence of cardiovascular risk factors in the urban industrial population was adopted. Three components of the study were: (a). Questionnaire-based survey for behavioral risk factors, (b) Anthropometric measurements and (c) Biochemical measurements. A questionnaire based assessment has been carried out through trained field investigators. Physical measurements were recorded by standardized equipments. Biochemical analysis for fasting blood sugar and lipid profile were assessed by local reputed laboratory in Chennai.

Conceptual definitions:

Self reported smoking duration, frequency and quantity was estimated using a questionnaire. Individuals were classified as ex smokers, current smokers or non smokers. "Current smoker" was defined as a person who had smoked at least 100 cigarettes over their lifetime, and continued to smoke every day or some days. "Ex-smoker" was defined as a person who had smoked more than 100 cigarettes over their lifetime and who did not smoke every day or some days during last 6 months. Study subjects who are smokers but do not fit the definition of current or Ex-smokers are classified as "others". "Non Smokers" are defined as those who have never smoked

Self reported Alcohol intake was assessed using structured questionnaire and individuals were classified as present, past, and non consumer. "Present consumer" was defined as person who continued to consume alcohol everyday or some days. "Past consumer" was defined as person who was consuming alcohol in the past and stopped taking alcohol any time prior to the interview. "Non consumers" were defined as those never having consumed alcohol.

Diet survey and physical activity assessment could not be carried out due to time constraints.

Anthropometric measurements:

Weight was measured in the upright position to the nearest 0.1 kg using calibrated balance beam scale. Height was measured without shoes and with light clothing to the nearest 0.1 cm using staturometer. Body mass index was calculated by dividing weight (kg) by height squared ($m^{2)}$. Subjects were classified into four categories based on the recently recommended cut off values for Asians to estimate the cardiovascular risk: i.e.;

less than 18.5 kg/m2 underweight; 18.5-23 kg/m2 increasing but acceptable risk; 23-27.5 kg/m2 increased risk and 27.5kg/m2 or higher as high risk [WHO] Waist circumference was measured at narrowest point between lower end of the rib cage and iliac crest. Hip circumference was measured at the widest part of the hips (i.e) at the level of greater trocherinters (Bony point). Blood pressure was measured from the right arm after the subject had been sitting for at least 5 minutes using digital Blood Pressure apparatus. The average of two readings taken 5 minutes apart was recorded. Hypertension was defined as per WHO criteria or any person previously diagnosed and being treated with antihypertensive drugs.

Biochemical measurements:

Blood samples were analysed at a local reputed laboratory in Chennai. Five ml of blood was drawn from ante capital vein. Blood was collected in two test tubes. Reagent used for glucose was heparin sodium fluoride. Samples were collected after 10-hour overnight fasting period. Plasma glucose, total cholesterol, triglyceride, HDL cholesterol and LDL cholesterol were measured by an autoanalyser (Maxmat). Plasma lipids and glucose measurements were done within three hours. Glucose was measured using glucose oxidase- peroxidase method. Lipids were estimated using cholesterol oxidase-cholesterol peroxidase method. Diabetes mellitus was defined as fasting plasma glucose of > 126mg% or any person previously diagnosed and on oral hypoglycemic agents or insulin. NCEP ATP III guidelines were used to define dyslipidemias.

Metabolic syndrome:

NCEP ATP III definition was used for diagnosis of Metabolic Syndrome. Criteria included in the definition are abdominal obesity, defined as waist circumference >102

cm for men and > 88 cm for women, triglycerides $\geq$ 150 mg/dL, high density lipoprotein (HDL) cholesterol <40 mg/dL for men and <50mg/dL for women, blood pressure $\geq$130 / $\geq$ 85 mm Hg and fasting plasma glucose $\geq$ 100 mg/dL. When 3 of the 5 characteristics were present, metabolic syndrome was diagnosed. (Grundy)

VI - RESULTS

Socio-economic demographic profile

The data on socio-economic status, tobacco consumption, alcohol consumption and physical measurement were collected from 200 industrial workers. Blood sample for Bio-chemical measurements was collected from 185 (92.5%) industrial workers (Table 1).

Table 1: Distribution of Study subjects by Socio-Economic and Demographic (n=0)

Variable	No	%
Age (yrs)		
18-24	26	13
25-34	42	21
35-44	19	9.5
45-54	82	41
>55	31	15.5
Sex		
Male	199	99.5
Female	1	0.5
Marital status		
Married	159	79.5
Un married	41	20.5
Religion		
Hindu	186	93
Muslim	5	2.5
Christian	9	5.5
Education		
Primary	16	8
Secondary	84	42
Diploma	44	22
Degree	56	28
Family size		
<5 member	120	60
>5 member	80	40

The respondents age varied from 18 to 69 years. The mean ± s.d. for age is 42.5±12.84. However, 41% were in 45 to 54-age group and only 15.5 % where above 55 years of age. Workers were predominantly males (99.5 %). It was found that 80 of these

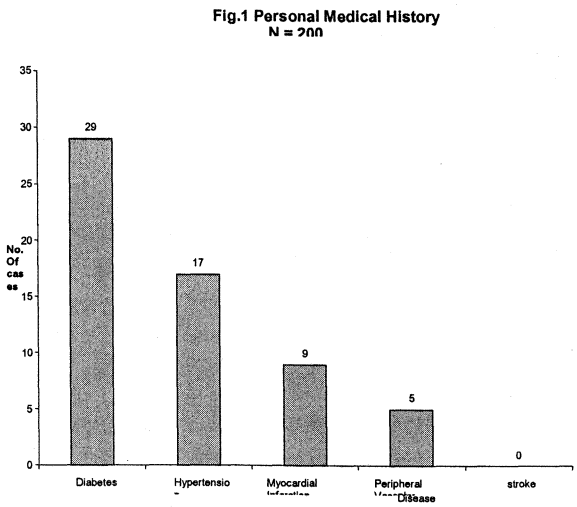
industrial workers were married. It was observed that more than 92 % were educated above primary school. The family size of less than five members was 60 % and above 5 members was 40 %.

Personal Medical History:

It was found that 14.5 % of them were suffering from diabetes mellitus and 8.5 % of them have hypertension by self reported history: Only 4.5 % and 2.5% gave history of myocardial infarction and Peripheral Vascular Disease (PVD) respectively (Table-2).

Table 2. Distribution of Study Subjects by Personal Medical History

Description	No	%
Hypertension	17	8.5
Diabetes	29	4.5
Myocardial Infarction	9	4.5
Stroke	0	0.0
PVD	5	2.5



Family Medical History:

Approximately 32 %, 9 %, 3.5 % and 10 % of study subjects gave a family history of hypertension, diabetes, myocardial infarction, stroke and sudden death respectively (Table-3).

Table 3. Distribution of Study Subjects by Family Medical History (n=200)

Description	No	%
Hypertension	63	31.5
Diabetes	71	35.5
Myocardial Infarction	18	9
Stroke	7	3.5
Sudden death	20	10

Life Style Factors :

Tobacco Consumption:

A distribution of the study subjects is profiled in Table 4.1

Table 4.1. Distribution of Study Subjects by Status of Tobacco Consumption

Description	No	%
Tobacco Consumers (past & present)	81	40.5
Non Consumers	119	59.5
Total	200	100

It was reported that 81 (40.5%) of them had ever consumed tobacco.

Types of tobacco consumption:

About 89% of them used tobacco in the form of smoking and 11% of them used smoke less products (Table 4.2)

Table 4.2. Distribution of Study Subjects by Types of Tobacco Consumed

Description	No	%
Smoking	72	89
Other forms of tobacco (snuffing chewing,)	9	11
Total	81	100

Details regarding type of tobacco consumption indicate that 72 (88.8%) smoke cigarettes, 14 (17.3%) chew tobacco by itself, 7 (8.6%) chew tobacco in combination with betel leaves (pan) and "Zarda" and 1 (1.2%) consume tobacco in the form of snuff (Table 4.3).

Table 4.3. Distribution of Study Subjects by Type of Tobacco Consumption

Description	No	%
Cigarette	72	88.8
Tobacco chewing with "Chuna"	14	17.3
Tobacco chewing with "Pan and Zarda"	7	8.6
Snuff	1	1.2

Duration of Tobacco consumption:

Mean age at which smoking started was 24.5±7.4 yrs mean duration of cigarette smoking was 15.8±11.5 years.

Current status of tobacco consumption

As per the definition of current smokers and ex-smokers sited in methods, it is observed that 19.5% of them are current smokers and 10.5% of them are ex-smokers (Table 4.4)

Table 4.4. Distribution of Study Subjects by Status of Tobacco Consumption (n=72)

Description	No	%
Current smokers	39	19.5
Ex. Smokers	21	10.5
Other (including smoker tobacco)	12	6
Total	72	36

Alcohol consumption:

It was observed that 88 (44%) of study subjects gave a history of ever-consuming alcohol (Table 4.5).

Table 4.5. Distribution of Study Subjects by Status Alcohol Consumption

Alcohol ever consumed	No	%
Yes	88	44
No	112	56
Total	200	100

Types of Alcohol Consumption:

The different form of alcohol consumption varied from 0.5% to 28% (Table 4.6)

Table 4.6. Distribution of Study Subjects by Types of Alcohol Consumption

Description	No	%
Toddy, arrack Local sprite	1	0.5
Rum, whisky, Gin, brandy (sprite)	56	28.
Beer	42	21
Wine	-	-

Status of alcohol consumption:

The status of alcohol consumption was assessed and it is reported than 66% of them are present consumers and 34% of them are past consumers. (Table 4.7).

Table 4.7 Distribution of Study Subjects by Status of Alcohol Consumption

Description	No	%
Present consumers	58	66
Past Consumers	30	34
Total	88	100

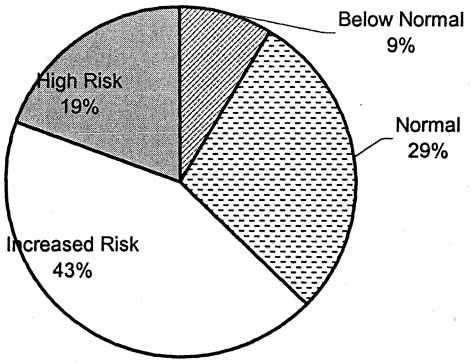
Body Mass Index:

The body mass index was confirmed for 185 individuas. It was noted that 80 (43.2%) and 36 (19.4%) were found to be having increased risk and high risk respectively for cardiovascular disease as per WHO cut off levels for Asians (Table 5).

Table 5. Distribution of Study Subjects By Body Mass Index

BMI Classification	**No**	**%**
Below normal (<18.5 kg/m^2)	16	8.6
Normal (18.5 – 23 kg/$m^{2)}$	53	28.6
Increased risk (23.1 – 27.5 kg/m)	80	43.2
High risk (>27.5 kg/m^2)	36	19.4
Total	185	100

Fig.2 Nutritional Status of the Study Population by BMI



Prevalence of Hypertension as per (WHO) definition

It is observed from the blood pressure measurements that 58 (29%) of study subjects were suffering from hypertension of varying grades as per WHO criteria (Table 6)

Table 6. Distribution of Study Subjects According to Blood Pressure Classification as per (WHO)

BP Classification	No	%
Normal SBP <140 mm of Hg or DBP<90 mm of Hg	142	71
Grade I SBP 140 – 159 mm of Hg DBP 90 – 99 mm of Hg	46	23
Grade II SBP 160 – 179 mm of Hg DBP 100 – 109 mm of Hg	9	4.5
Grade III SBP > 180 mm of Hg DBP > 110 mm of Hg	3	1.5
Total	200	100

Assessment of Bio-chemical parameters

Assessment of bio-chemical parameters for the study population was done for 185 individuals (Table-7). For 15 individuals the biochemical parameters were not done because they were unavailable.

Fasting Blood Glucose:

It was observed that 2.7% of study subjects had impaired fasting glucose level and 4.3% had high (126 mg/dl) glucose levels.

Table 7.1 Distribution of study subjects according to Fasting Blood Glucose (n=185)

Cut off values	No	%
Normal <110 (mg/dl)	172	92.9
Impaired fasting glucose-25 (mg/dl)	5	2.7
High 126 (mg/dl)	8	4.3
Total	185	99.9

Serum Cholesterol:

It was found that 27.5% of the study subjects had a total serum cholesterol 200 mg/dl (Table 7.2).

Table 7.2. Distribution of study subjects according to Serum Total Cholesterol (n=185)

Cut off values	No	%
< 200 (mg/dl)	134	72.4
200 (mg/dl)	51	27.5
Total	185	99.9

Triglycerides:

In the case of triglicerides, 16.3% of study subjects had levels 150 mg/dl

Table 7.3 Distribution of study subjects according to Triglyceride (n=185)

Cut off values	No	%
<150 (mg/dl)	155	83.7
150 (mg/dl)	30	16.3
Total	185	100

LowDensity Lipo- Protein:

It is observed that 32.4% of study subjects had high LDL cholesterol

Table 7.4 Distribution of study subjects according to High LDL Cholesterol

Cut off values	No	%
>_ 130 (mg/dl)	60	32.4
<130(mg/dl)	125	67.6
Total	185	100

High Density Lipo-protein:

In the case of High- Density Lipo-protein (HDL) observed that 11.9% of male and 0.5% of females had cut off values below 40 and 50mg/dl respectively.

Table 7.5 Distribution of study subjects according to High-Density Lipo –Protein (HDL) (n=185)

Cut off values	No	%
Male (<40 mg/dl)	22	11.9
Female (<50mg/dl)	1	0.5
Total	23	12.4

Cholesterol / HDL Ratio:

Thirty four percent of the study subjects had a Cholesterol/ HDL Ratio 4.5.

Table 7.6 Distribution of study subjects according to Cholesterol / HDL Ratio (n=185)

Ratio	No	%
<4.5	122	65.9
4.5	63	34
Total	185	99.9

Prevalence of each component of the metabolic syndrome

1. Abdominal obesity waist circumference >102 cm for men. > 88 cm women.
2. Low high density lipoprotein-cholesterol:< 40 mg/dl for men, < 50 mg/dl for women
3. Prevalence of metabolic syndrome in the study population 14/185= 7.6%.

The prevalence of each component of metabolic syndrome was observed as per ATP criteria. It was 14.5%, 16.2%, 11.8% 50.2% and 20.5% for abdominal obesity, triglyceride, HDL, blood pressure and fasting glucose respectively. The over all prevalence of metabolic syndrome was 7.6%.

Table 8. Prevalence of each component of the metabolic syndrome and clustering of component among the study population. (n=185)

Variables	No	%
Abdominal obesity [1]	27	14.5
Triglycerides >150 mg/dl	30	16.2
HDL Cholesterol [2]	22	11.8
Blood pressure >135/85 mm/ Hg	93	50.2
Fasting glucose >110 mm/dl	38	20.5
1 Component	72	38.9
2 Component	43	23.2
3 Component	07	3.7
4 Component	04	2
5 Component	03	1.6

VII - DISCUSSION

This study describes a comprehensive summary of major cardiovascular risk factors in an urban industrial population in Chennai City of South India. A high prevalence of smoking, alcohol consumption, BMI in high-risk range, hypertension, diabetes and dyslipidaemias were observed in the study population. Clustering of risk factors and a high prevalence of metabolic syndrome was alsoi observed. These finding are in keeping with those of Isoma Betai et al, 2001[46].

In national survey in India, prevalence of tobacco consumption was 32.9% (Subramanium,S.V)[47] nationally and is the range of 11-26% for Tamil Nadu State. In contrast, the observed prevalence of smoking was 33.8% in our study.

Recently, WHO described a stratification of Body Mass Index for Asian population [48]. into 4 groups. Using this classification, we found 43.2% and 19.4% of individuals were at increased risk and high risk respectively. The study subjects with BMI >23 kg/m^2 was increasing across the age groups and found to be statistically significant ($P<0.05$). A study from Northern India showed prevalence of central obesity 57.4% in men and 68.4% in women (Gupta R). In contrast, in our study nearly 14.5% of the subjects had central obesity.

A high prevalence of Hypertension 29% was observed in our study. This is in agreement with other Indian studies, where, prevalence of 28% and 36% (Men) was reported [9].

Regarding diabetes, a high prevalence of 29% was found in the our study population. This was higher than the prevalence reported in the national survey done in six majors cities in India, where age standardized prevalence of diabetes was 12.1%

(Ramachandran DEIS); Furthermore, of the total diabetics in the study population, 3-9% had pre-existing history of diabetes while 6% were newly detected. A high prevalence of diabetes across all age groups was observed.

The proportion of study subjects with various dyslipidemias was lower than reported from another recent study from North India where similar criteria were used [50]. The most common dyslipidemia in this study was raised LDL (>130mg%). It was seen in 32.6% of the subjects as compared to 37% to the above cited study[50] where the most common dyslipidemia for both males and females was low HDL, cholesterol <40 mg/dl (Males 54.9% females 54.2%). However, in our study it was 12%. The high level of triglycerides (16.3% - >_150mg/dl), is much larger than that study. This could probably be attributed to different dietary patterns in various parts of India.

The NCEP, ATP III definition was used for metabolic syndrome. In our study, prevalence of metabolic syndrome was 23.2% . That is comparable to two other studies i.e. in one study it was 12.8% (Gupta K). There is increase in the prevalence of metabolic syndrome - 13.1% in study subjects > 45 years of age in our study. Among the five components of metabolic syndrome, there was a significant increase in the Odds Ratio for high blood pressure, high blood glucose and abdominal obesity in study subjects aged above 45 years (P <0.05).

There were limitations in this study. Firstly study sample size is small. Age distribution was not representative of general population and sex was unequal with most of the subjects being males. Our study subjects belonged to the urban middle and higher socioeconomic classes. Because of time constraints, physical activity and diet assessments could not be carried out.

VIII - CONCLUSION

Based on the results of this study, the following conclusions can be arrived at:

(1). High prevalence of multiple risk factors such as smoking, alcohol, consumption and BMI in high risk range was observed in this study.

(2). Clustering of hypertension, central obesity, dyslipidemia and diabetes observed in one third of the study population

On the basis of the above conclusions, the hypotheses proposed have been verified.

IX – RECOMMENDATIONS

Since this study was carried out on a selected Industrial population of sample size 200 only (to overcome time and other feasibility constraints), it is recommended that similar studies be conducted on larger samples to reconfirm the findings of this study.

The sample size notwithstanding, since prevalence of risk factors such as smoking, BMI, Hypertension, Diabetes, Metabolic Syndrome are high, in this study population, it is suggested that planned IEC activities be initiated for them to bring about a favourable shift in the prevalence of these risk factors.

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ANNEXURE

PREVALENCE OF RISK FACTORS FOR CARDIOVASCULAR DISEASE AMONG INDUSTRIAL WORKERS, IN CHENNAI CITY

Cardiovascular Disease Proformae

Form-1 : Base line survey

Form-2 : Section 1: Tobacco consumption

Section 2: Alcohol consumption

Section 3: Measurements

PREVALENCE OF RISK FACTORS FOR CARDIOVASCULAR DISEASE AMONG INDUSTRIAL WORKERS, IN CHENNAI CITY

FORM- 1: BASE LINE SURVEY

1) Industry name---------- ☐

Name of the Employee ---------- SL.No ☐☐☐☐

3) a) Age(year) ☐☐ b)Gender ☐ c)Marital status=1/UN. M=2 ☐

4) Employment grade (occupation)

5). Employment no ☐☐☐☐ ☐☐☐

6). ADDRESS (Residential address)----------

Religion- Hindu (1), Muslim (2), Christian (3), Others (4) ☐

7) Education Primary=(1), Secondary= (2), Diploma=(3),& Degree=(4) ☐

8) No of members in the household Adults ☐☐ ☐ Children ☐

8) a) TC ☐ AC ☐

Personal Medical history	Present (1)/ Absent (2)	If present, duration		
9) High blood pressure	☐	☐☐	☐☐	☐
10) Diabetes	☐	☐☐	☐☐	
11) Heart attack/Pain in chest on exertion	☐	☐☐	☐☐	
12) Stroke	☐	☐☐	☐☐	
13) Pain in the leg muscles on walking: Relived on rest	☐	☐☐	☐☐	

Family Medical history: (Either mortality or morbidity) Yes (1) / No (2)
(ie; Brothers, sisters, Father, Mother, In-Laws)

14) Heart attack	☐
15) Stroke	☐
16) High blood pressure	☐
17) Diabetes mellitus	☐
18) Sudden death	☐

Remarks;

Date---------- SIGNATURE OF THE INVESTIGATOR

PREVALENCE OF RISK FACTORS FOR CARDIOVASCULAR DISEASE AMONG INDUSTRIAL WORKERS, IN CHENNAI CITY

FORM-2 GENERAL PARTICULARS SECTION 1 Tobacco consumption

1) Industry name----------

2) Name of the Employee ---------- SL.NO ☐☐☐☐

3) a) Age (year) ☐☐ b)Gender: M (1), F(2) ☐ c) Marital status: M=1/UN.M=2 ☐

4) Employment grade (occupation) ☐☐☐

5) Employment no ☐☐☐☐

6) Have you ever smoked/consumed any form of tobacco(code,Yes=1.No =(2)
(if answer is "no" proceed to SECTION 2)

7) Form of tobacco consumption

a), Smoking ☐

b). Chewing ☐

c). Other forms (Snuff, tooth past etc) ☐

d). Are you exposed to tobacco athome or at place of work regularly? ☐

8) How old were you when you smoked a whole cigarette for the first time. ☐☐

9) How old were you when you used chewing tobacco/ snuff for the first time. ☐☐

10) Do you currently consume tobacco by smoking / chewing / snuff. ☐

11) State the age since quitting

Year / month ☐☐ ☐☐

12) Tobacco consumption pattern:

Form of Tobacco	Avg.Amt/Day	No of days/ wk	No of days/Month	occasionally No of days in a year	Total duration Since started Yr. month
1)Cigarettes					
2). Beedi					
3). Tobacco Chew					
4) Snuff					
5). Pan with Zarda					
6). Others (specify).					

RM-2 SECTION 2 Alcohol consumption

1) Industry name----------

Name of the Employee ---------- SL.NO ☐☐☐☐

3) a) Age (year) ☐☐ b)Gender: M (1), F(2) ☐ c) Marital status: ☐
M=1/UN.M=2

4) Employment grade (occupation) ☐☐☐

5) Employment no ☐☐☐☐

6) Have you ever consumed alcoholic beverages (YES=1, NO=2) if ANS is no

Proceed to SECTION 3

7) Do you use alcohol beverages?

Currently using alcohol regularly=1

Currently using alcohol occasionally (less than once a week) =2 ☐

Used alcohol in the past (stopped more than 6 month ago) =3

Recently stopped alcohol (less than 6 month ago) =4

8)Alcohol use:

Type of Alcohol	Avg. Amt. a at time	Avg. no of days/ week	Avg. no of days/ Month	Occasionally no of days in a year	Total duration Since started Year Month
1). Local spirits (toddy, arrack)					
2). Spirits: Rum Whisky, Gin, Brandy					
3) Beer					
4) Wine					
5) Others (specify)					

Conversion: 1 small peg-30 ml, large peg-60 ml, large glass of beer-325 ml,
One glass of wine-100 ml.)

PREVALENCE OF RISK FACTORS FOR CARDIOVASCULAR DISEASE AMONG INDUSTRIAL WORKERS, IN CHENNAI CITY

FORM 2 SECTION –3 Measurements

1) Industry name----------

2) Name of the Employee ---------- SL.NO

3) a)Age(year) b)Gender: M (1), F(2) c) Marital status:
M=1/UN.M=2

4) Employment grade (occupation)

5) Employment no

Physical measurements: (Two measurements are recorded within 15 min gap)	**1)Measurement**	**2) Measurement**
1) Height (cms)		
2) Weight (kgs)		
3) West circumference (cms)		
4) Hip circumference (cms)		
5) Blood pressure (mm of Hg)		
6) Pulse rate (per/min)		

Blood Biochemistry (optional)

!) Whether any blood examination done: (Yes=1, No=2)

2) Check fasting status (Yes=1, No=2)

3) Fasting blood levels of,

1) Plasma Glucose----(mg/dl)
2) Total cholesterol----(mg/dl)
3) DL cholesterol----- (mg/dl)
4) Triglyceride---------- (mg/dl)
5) LDL Cholesterol

Date Signature of investigators

Acronyms

ARMA	Arma laboratory
BP	Blood pressure
BMI	Body mass index
CAD	Coronary artery disease
DM	Diabetic mellitus
LDL	Low density lipo- protein
HDL	High density lipo protein
N=	Number
PVD	Peripheral vascular disease
SBP	Systolic blood pressure
DBP	Diastolic blood pressure
WHR	West hip ratio
ATP	Adult treatment plan
NCEP	National cholesterol educational programme