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Original Research Article

Prevalence and risk factors of dyslipidemia among male industrial workers in India

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ABSTRACT

Background: Lipid Abnormalities are major risk factors for coronary artery diseases. Prevalence of dyslipidemia is high in India shown by various studies due to lifestyle changes. This study was conducted to estimate the prevalence of dyslipidemia and its association with body fat percentage, body mass index, diabetes, tobacco use and hypertension.
Methods: A cross-sectional study was conducted among 300 male employees from a packaging and binding industry in Maharashtra. Behavioural data, anthropometric measurements and blood collection were conducted by trained staff using standard instruments.
Results: Majority of the participants were in the age group between 30-60 years. Overall prevalence of dyslipidemia was 50.7% among study subjects.15.3%, 27% 62%, 23% and 50.7% of participants had high serum cholesterol, high triglycerides, low high density lipoprotein (HDL), high low density lipoprotein (LDL) and high cholesterol/HDL ratio respectively. Logistic regression analysis showed abnormal cholesterol level was associated with high body fat percentage and hypertension. Abnormal triglyceride level was associated with high blood sugar and hypertension. High LDL level was associated only with hypertension. Abnormal HDL level and high cholesterol/HDL ratio was strongly associated with age (>40 years).
Conclusions: The prevalence of dyslipidemia was high among male industrial workers in India. Screening programs should be conducted at work places for early detection of dyslipidemia. Information, education and communication (IEC) programs based on lifestyle modification like healthy diet habits, regular physical activity for weight control and tobacco cessation need to be implemented at work places.

Keywords: Prevalence, Dyslipidemia, Risk factors, Industrial workers

INTRODUCTION

Dyslipidemia is elevation of plasma cholesterol, triglycerides (TGs), or both, or a low high-density lipoprotein (HDL) or high low density lipoprotein (LDL) levels that contributes to the development of atherosclerosis.[1] Atherosclerosis of the arterial vessel walls is the most important underlying cause of cardiovascular diseases (CVD) and dyslipidemia is a major and primary risk factor of atherosclerotic CVD.[2]

Cardiovascular diseases are the leading cause of death in the world, leading to almost 32% of all deaths in women and 27% in men in 2004. 35 million deaths (60% of total

global mortality) annually are due to cardiovascular diseases.[3-5]

Association of dyslipidemia with the development of cardiovascular disease (CVD) is well studied and guidelines for management of dyslipidemia have been published. Serum total cholesterol is usually used as a measure for monitoring at the population level, especially in developing countries. In the past few decades, data from several countries reported a high prevalence of dyslipidemia and unsatisfactory results of dyslipidemia management.[6-10]

Economic development and improvement in the standard of living have led to changes in eating habits and lifestyle in India. This has contributed to increase in the number of people suffering from dyslipidemia and atherosclerotic cardiovascular diseases (ASCVD). Studies have demonstrated that low-density lipoprotein cholesterol (LDL-C) seemingly crucial for ASCVD while high-density lipoprotein cholesterol (HDL) protect against ASCVD. As per guidelines of NCEP (adult treatment panel III) an elevated level of cholesterol, including non-HDL-C and LDL-C, is a root cause of atherosclerosis, the key underlying process contributing to most of clinical ASCVD.[6] Most dyslipidemia guidelines recognize LDL as the major atherogenic lipoprotein and consequently identify LDL-C as the primary target of therapy and also cholesterol levels >200 and triglyceride levels >150 are considered for therapy.[11,12]

Strong evidence indicates that high LDL concentrations initiate atherogenesis and promote atherosclerosis at every stage.[13] Hypertension is a major risk factor for coronary artery disease and ischaemic as well as haemorrhagic stroke.[14]

The major risk factors for atherosclerotic cardiovascular disease (ASCVD) include cigarette smoking, hypertension, low HDL-C, and diabetes mellitus. They act at one or more steps in atherogenesis to enhance the formation of plaques or cause plaque rupture. These factors include proinflammatory and prothrombotic states, and some forms of dyslipidemia. Underlying risk factors are atherogenic diets, obesity, physical inactivity, and genetic tendencies.[5] Advancing age is usually listed as a major risk factor; but age per se is not a cause of atherosclerosis, as atherogenesis progresses throughout life, a person's age commonly reflects atherosclerotic burden; importantly, however, the extent of atherosclerotic burden at a given age varies greatly from one individual to another.[15,16]

Behavioural risk factors, including tobacco use, alcohol abuse, physical inactivity and unhealthy diet are responsible for 80% of coronary heart disease and cerebrovascular diseases.[17] Dyslipidemia is one of the modifiable risk factors for the development of atheroscelorosis, stroke and cardiovascular diseases (CVDs). Besides cholesterol lowering, public health preventive measures are needed to identify and treat individuals with risk factors, especially obesity, physical inactivity, tobacco use and hypertension.[18]

Several epidemiological studies have proved the value of reducing T-C and LDL-C in primary and secondary prevention of CVD. The seven countries study, WHO MONICA project, multiple risk factor intervention trial, Framingham Heart Study, Migration and Stockholm studies have established the association of high serum cholesterol with risk of CVD.[19] ICMR INDIAB study reported high prevalence of dyslipidemia (79%) among adults in 4 regions of India. The highest prevalence of dyslipidemia was found in Chandigarh followed by Jharkhand Tamil nadu and Maharashtra.[20]

The objective of this health study was to assess the prevalence of dyslipidemia, hypertension, diabetes mellitus and factors associated with dyslipidemia among male industrial workers in the Maharashtra state of India.

METHODS

Study sample and design

This cross sectional study on prevalence of dyslipidemia and risk factors associated with it was conducted in a packaging and binding industry in Palghar district of Maharashtra, India This health survey was conducted among 300 male employees above 30years of age in the company over a period of one week in March 2014.

Data collection and measurements

A detailed questionnaire was administered to 316 male employees by trained medical staff. Data on demographic characteristics, medical history, tobacco consumption, and family history of hypertension and diabetes were recorded in the questionnaire. Anthropometric measurement was conducted by trained persons. Out of total 316, 16 employees who were suffering from any of the ailments such as heart disease, tuberculosis, COPD were excluded from the study.

Body weight and height was measured with participants standing without shoes and in light clothes. Body weight was measured in Kilograms. Height was measured in centimetres. Body mass Index (BMI) was calculated as weight in kg/ (height in meters)^2. Body fat percentage was estimated using Omron Body Fat monitor Model: HBF - 306. Blood pressure was measured using standard mercury sphygmomanometer on right arm in sitting position after participant rested for minimum 10 minutes. Blood pressure was measured twice and the average reading was recorded.

Blood samples were collected from all participants after an overnight fasting. All the biochemical assessments were conducted in standard laboratory. Concentrations of fasting glucose, total cholesterol, HDL C, Triglycerides,

LDLC were measured using SD auto analyzer Transasia Biomedicals Ltd, Model: Biochemistry Analyser Erba Chemical Touch (Domestic) 106304.

Definition of variables

Diabetes Mellitus was defined as Fasting blood sugar 126mg/dl according to WHO diagnostic criteria for diabetes mellitus.[21] Blood pressure ≥140/≥90mm Hg was defined as hypertension (WHO classification for hypertension).[22]

Body mass index (BMI) was classified based on World Health Organization classification. In this study, the data was analysed for those with BMI between 18.5- 24.9 classified as normal weight and those above 25 were overweight/obese.

Body fat percentage was calculated as 15-20 acceptable, 21-24 overweight and >24 obese for males.[23]

Lipid abnormalities were calculated as total cholesterol (TC) >200, serum triglyceride >150, low density lipoprotein (LDL) >130 mg/dl, high density lipoprotein (HDL) <40. Cholesterol/ HDL ratio >4.5 according to the criteria set by the National Cholesterol Education Program-Adult Treatment Panel III (NCEP ATP III).[6]

Statistical analysis

The data was analysed using SPSS-17 version. Continuous variables were presented as mean ±S.D. correlation. Multiple logistic regression analysis was used to find out association between various risk factors like age, body mass index, body fat percentage, hypertension, diabetes mellitus and tobacco use with dyslipidemia. The exponential B value with 95% Confidence Interval for Exp (B) were presented and $p<0.05$ was considered to be statistically significant.

RESULTS

Table 1: Age wise distribution of study subjects.

Age group (years)	Number	Percentage (%)
30-40	112	37.33
41-50	128	42.67
51-60	58	19.33
>60	02	0.67
Total	300	100

Table 1 shows 37.3% were in the age group of 30-40 years, 42.7% were in the age group of 41-50 years and 19.3% were in the age group of 51-60 years.

Table 2: Mean standard deviation and confidence Intervals of risk factors associated with coronary heart disease.

Variables	Mean	Std. deviation	LCI	UCI
Body mass index (BMI)	24.8475	3.89424	24.4050	25.2899
Body fat percentage	27.8083	4.72501	27.2715	28.3452
Systolic blood pressure	120.1867	11.09363	118.9262	121.4471
Diastolic blood pressure	80.2067	9.97106	79.0738	81.3396
Fasting blood sugar	97.07	32.799	93.34	100.80
Serum cholesterol	170.2360	31.46789	166.6607	173.8113
Serum triglycerides	127.6790	58.31284	121.0536	134.3044
High density lipoprotein (HDL)	40.3813	8.53708	39.4114	41.3513
Low density lipoprotein (LDL)	108.5533	29.47713	105.2042	111.9025
Cholesterol/HDL	4.3140	.95996	4.2049	4.4231

Table 3: Prevalence of risk factors associated with dyslipidemia among study subjects.

Risk factors	Category	Frequency (n=300)	Percentage (%)
Body mass index	Abnormal	134	44.7
	Normal	166	55.3
Body fat	Abnormal	221	73.7
	Normal	79	26.3
Blood pressure	Abnormal	27	9.0
	Normal	273	91.0
Blood sugar	Abnormal	19	6.3
	Normal	281	93.7
Family history diabetes mellitus	Yes	34	11.3
	No	266	88.7
Family history of hypertension	Yes	41	13.7
	No	259	86.3
Tobacco use	Yes	176	58.7
	No	124	41.3

Table 4: Prevalence of dyslipidemia among study subjects.

Lipid profile	Category	Frequency (n=300)	Percentage (%)
Cholesterol	Normal	254	84.7
	Abnormal	46	15.3
Triglycerides	Normal	219	73.0
	Abnormal	81	27.0
High density lipoprotein (HDL)	Normal	114	38.0
	Abnormal	186	62.0
Low density lipoprotein (LDL)	Normal	231	77.0
	Abnormal	69	23.0
Cho/HDL	Normal	148	49.3
	Abnormal	152	50.7

Table 5: Age wise distribution of lipid abnormalities.

Age group (years)	Hypercholesterolemia (%)	Hypertriglyceridemia (%)	Abnormal cholesterol/ HDL ratio (%)
30-40	13.4	34.8	35.7
41-50	14.1	21.1	56.3
51-60	20.7	25.9	65.5
>60	50	0	100

Table 6: Prevalence of dyslipidemia among males with the risk factors associated with coronary heart disease.

Risk Factors		Hypercholesterolemia	Hypertriglyceridemia	Abnormal Cholesterol/HDL ratio
BMI (%)	Abnormal	18.7	31.3	54.5
	Normal	12.7	23.5	47.6
Body Fat (%)	Abnormal	18.6	30.8	51.1
	Normal	6.3	16.5	49.4
Blood Pressure (%)	Abnormal	40.7	44.4	66.7
	Normal	12.8	25.3	49.1
Blood sugar (%)	Abnormal	15.8	63.2	42.1
	Normal	15.3	24.6	51.2
Family h/o HT (%)	Yes	14.6	39	41.5
	No	15.4	25.1	52.1
Family h/o DM (%)	Yes	20.6	35.3	61.8
	No	14.7	25.9	49.2
Tobacco users (%)	Yes	16.9	25	54
	No	14.2	28.2	48.3

Table 2 shows the mean body mass index (BMI) and body fat percentage of study subjects was 24.85 and 27.81 respectively. Mean systolic and diastolic blood pressure was 120.19 and 80.21 respectively. Mean fasting blood sugar was 97.07. Mean serum total cholesterol, triglyceride, HDL, LDL, cholesterol/HDL ratio was 170.24, 127.68, 40.38, 108.55 and 4.31 respectively.

Table 3 shows 44.7% participants had high BMI ≥25, 73.7% had high body fat percentage. 9% of study participants were found to have high BP (Hypertension) for first time. 6.3% had high blood sugar. 58.7% had habit of chewing tobacco.

Table 4 shows 15.3% of the participants had hypercholesterolemia. 27% had hypertriglyceridemia, 62% had low serum HDL and 23% had high serum LDL, 50.7% had high cholesterol/HDL ratio.

Table 5 shows, 20.7% male participants between 51-60 years age group had hypercholesterolemia as compared to 14.1% and 13.4% among 41-50 years and 30-40 years respectively. 34.8% participants had hypertriglceridemia in 30- 40 years age group which was high as compared to older age group. 65.5% in the age group 51-60 years had high cholesterol/HDL ratio as compared to 35.7% and 56.3% among 30-40 years and 41-50 years respectively.

Table 6 shows 18.7%, 31.3% and 54.5% with high BMI had hypercholesterolemia, hypertriglyceridemia and abnormal cholesterol/HDL ratio respectively as compared to those with normal BMI. 18.6%, 30.8% and 51.1% with high body fat% had hypercholesterolemia, hypertriglyceridemia and abnormal cholesterol/HDL ratio respectively as compared to those with normal body fat%. 40.7%, 44.4% and 66.7% having hypertension had hypercholesterolemia, hypertriglyceridemia and abnormal Cho/HDL ratio respectively as compared to those with normal blood pressure. 16.9% and 54% tobacco users had hypercholesterolemia and abnormal Cholesterol/HDL ratio respectively as compared to non users.

Table 7: Logistic regression analysis showing relationship between risk factors and lipid profile values.

Variables	Cholesterol						
	Category	B	Wald	Sig.	Exp (B)	95% C.I. for Exp (B)	
						Lower	Upper
Hypertension	No	Reference					
	Yes	1.595	12.163	.000	4.931	2.011	12.087
Body fat	Normal	Reference					
	High	1.255	5.555	.018	3.509	1.235	9.965
		Triglycerides					
Blood sugar	Normal	Reference					
	Abnormal	1.758	11.097	.001	5.802	2.062	16.323
Hypertension	No	Reference					
	Yes	.895	3.989	.046	2.447	1.017	5.889
		HDL					
Age group	≤40	Reference					
	>40	1.096	18.360	.000	2.992	1.812	4.940
		LDL					
Hypertension	No	Reference					
	Yes	1.179	7.299	.007	3.250	1.382	7.643
		CHO/HDL					
Age group	≤40	Reference					
	>40	1.113	18.275	.000	3.043	1.827	5.068
Hypertension	No	Reference					
	Yes	1.179	7.299	.007	3.250	1.382	7.643

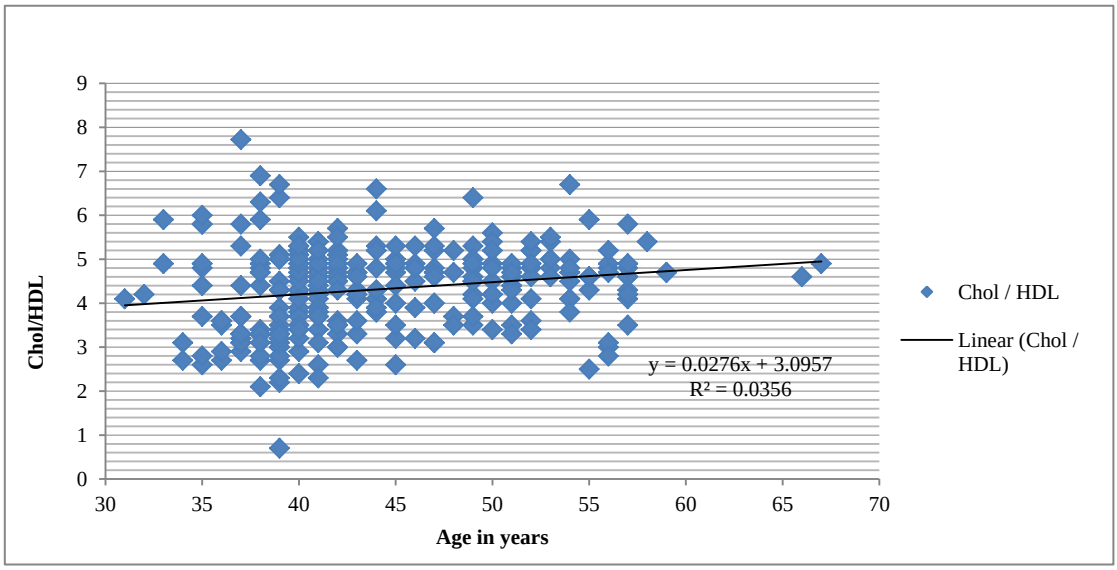

Figure 1: Graph shows linear correlation between age and cholesterol/HDL ratio.

Table 7 shows logistic regression analysis, abnormal serum cholesterol level was associated with high body fat percentage and hypertension. Abnormal serum triglyceride level was associated with high blood sugar and hypertension. High LDL level was associated only with hypertension. Abnormal HDL level was associated with age and high cholesterol/HDL ratio was associated with age (>40 years) and hypertension.

The linear correlation graph shows positive correlation of cholesterol/HDL ratio levels with age. The cholesterol/ HDL ratio increases with age.

DISCUSSION

Overall the prevalence of dyslipidemia was high (50.7%) among male industrial workers. Hypercholesterolemia, hypertriglyceridemia, low HDL levels, high LDL levels and high cholesterol/HDL ratio was observed in 15.3%, 27%, 62%, 23% and 50.7% study subjects respectively. Multivariate analysis showed dyslipidemia was significantly associated with age, obesity, tobacco use, hypertension and diabetes.

This study findings are almost similar to the ICMR INDIAB study which also showed majority of Indians had high percentage of low HDL, Of the subjects studied, 13.9% had hypercholesterolemia, 29.5% had hypertriglyceridemia, 72.3% had low HDL-C, 11.8% had high LDL-C levels. Blood pressure was significantly higher in those with any lipid abnormality. Dyslipidemia was strongly and positively associated with age ≥60 years, urban residence, overweight, obesity, diabetes and hypertension.[20,24] Prevalence of dyslipidemia and hypercholesterolemia was 52.7% and 63.8% respectively among males in Warangal (AP). Association of hypercholesterolaemia with age, sex, body mass index and blood pressure was tested using logistic regression analysis.[26] In a village population, in North Kerala, the prevalence of hypercholesterolaemia was 63.8%. High prevalence was seen in those who had a BMI ≥25 kg/m^2 (69%) and hypertension (68.8%).[26] The findings of these studies almost correlate with the present study.

When compared with studies conducted in different countries. The prevalence of dyslipidemia in this study was higher than Korean population (44%).[15] Among the Chinese population it was 35.5%. 44.2% had isolated hypertriglyceridemia, 14.7% had hypercholesterolemia and 28.0% had isolated low high-density lipoprotein cholesterol. Multivariable logistic regression analysis revealed that dyslipidemia was associated with age, education level, and physical activity, obesity in both men and women.[19]

Dyslipidemia was high in Jordan population (75%) 48.8% had high TC level, 40.7% had high LDL-C, 40.1% had low HDL-C, 43.6% had high triglyceride levels. Age was associated with high triglycerides, high LDL-C, and high TC. Overweight and obese subjects had greater odds of having high triglycerides, high TC, and low HDL-C. Diabetes was associated with increased odds of high triglycerides only.[27] The findings were similar to the present study.

Studies from Asia Pacific region showed 33% prevalence of low HDL-C, Overall, low HDL-C levels were more associated obesity and diabetes mellitus compared with normal levels of HDL-C.[28] Dyslipidemia was identified in 14% study subjects in a Canadian cohort study.[29]

Prevalence of dyslipidemia was 51.8% among Iranian population similar to this study. The prevalence of hypercholesterolemia was 11.4%, hyper-low-density lipoprotein cholesterol was 9.6%, hypertriglyceridemia was 25% and hypo-high-density lipoprotein (HDL) was 34.3%.[30]

Overall, 66.5% of Thai population had some form of dyslipidemia. Prevalence of high LDL-C, low HDL-C, and high triglycerides were 29.6%, 47.1%, and 38.6%, respectively.[31]

The prevalence of dyslipidemia and hypertriglceridemia among Saudi population was about 40% and 44% respectively. Logistic regression analysis revealed that obesity/overweight, age, diabetes were the most important significant predictors of dyslipidemia.[32]

A meta-analysis study from 29 articles in Iran showed high prevalence of dyslipidemia. The prevalence of hypercholesterolemia, hypertriglyceridemia, high LDL and low HDL among Iranian people was 41.6%, 46.0%, 35.5% and 43.9% respectively, except for low HDL which was much higher in this study.[33]

The Trabzon lipid study showed prevalence of hypercholesterolemia was 37.5%, elevated LDL-C was 44.5%, HDL-C was 21.1%, hypertriglyceridemia was 30.4% among Turkish adults.[34] Dyslipidemia was highly prevalent in all the geopolitical zones of Nigeria with the consistent pattern being low HDL-Cholesterol and high LDL-C.[35]

The prevalence of high blood cholesterol associated with increasing BMI was greatest among Mexican American younger men. Men aged 20 to 39 years with a BMI of ≥27 had more than twice the prevalence of high blood cholesterol as men of that age with a BMI of <25. For men, the direct effects of age and the interaction between BMI and age were significant for high blood pressure and low HDL-C. In regression analysis, low HDL-C was related positively to BMI.[36] The results were similar to this study.

The high prevalence of dyslipidemia among these workers could be due to consumption of unhealthy diet and lack of physical activity. There could be lack of awareness about benefits of healthy diet and regular physical activity in this population. Emphasis should be given on regular awareness programs on lifestyle modification and its benefits for reducing the risk of cardiovascular diseases at work places. Screening programs for early detection of dyslipidemia should be conducted at work places. Those detected with dyslipidemia should be treated with lipid lowering drugs along with physical exercise and healthy diet which will

help to prevent the development of atherosclerotic cardiovascular diseases (ASCVDs).

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