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To Assess the Impact of Smoking on Cardiomyopathy in Individuals with Diabetes

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Abstract

Diabetes mellitus is a metabolic disorder associated with a variety of complications in individuals with poor glycaemic control. Cigarette smoking is one of the harmful risk factors to exacerbate coronary and peripheral disease. It has been shown to cause impairment in coronary blood flow response which increases the risk of myocardial ischemia in patients. The long-lasting DM leads to DCM and along with smoking the severity of DCM is intensified. The present study was conducted to determine the role of smoking in the early onset of diabetic cardiomyopathy. It was a cross sectional study conducted on total 150 males among which 75 were smokers and 75 were non-smokers of age 40 to 70 years. Selected participants were requested to fill a questionnaire regarding socio- demographic data, smoking habits, severity and characteristics of cardiomyopathy, stress, lifestyle and family's medical history. Their anthropometric indices were measured, blood samples were taken in which glucose level, HDL, LDL and triglycerides level were checked and body vitals were also measured. The patients underwent a complete ECG and echocardiography to evaluate difference of heart anatomy and physiology of diabetic smokers and non-smokers. (Barengo et al., 2017)

In anthropometric indices, body mass index and waist-to-hip ratio show significant difference with p-value of 0.025 and 0.018 respectively. Systolic BP and pulse rate give significant difference with p-value of 0.000. Total cholesterol, triglyceride, high density lipoprotein and low-density lipoprotein show significant difference with p-value 0.000 of each. Age is also directly linked to onset of DCM showing significant difference at p-value 0.028. Body fat percentage, diastolic blood pressure and fasting plasma glucose do not reveal any significant difference between diabetic smokers and non-smokers.

The most prominent symptoms observed in smokers are breathing trouble, chest pain, swelling of abdomen, and fatigue while there is a significant difference in breathing trouble, swelling of abdomen and swelling of legs and feet. 27% of smokers have been smoking for 21 to 30 years while 90.7% smokers had family history of diabetes mellitus. The odds were estimated which showed that diabetic smoker are 1.16 times more likely to have increased BMI, 1.142 times more at risk of having high body fat percent, 1.037 and 1.045 times more likely to have high systole BP and pulse rate respectively. FPG, total cholesterol, triglyceride and LDL are 1.001, 1.096, 1.063 and 1.087 times more likely to increase respectively in diabetic smokers than non-smokers. FPG shows remarkable correlation with age, body fat percentage and diastolic BP. Total cholesterol, triglyceride and LDL show correlation with and systolic BP, pulse rate. The transthoracic echocardiography examination revealed that ejection fraction of smokers was 29.1 ± 6.0. The mitral valve thickness was found to be +12.5% and the mitral E_a/A_a observed was -8.1%. The increased in left ventricular mass was also detected. Posterior wall thickness was found to be 18. The ejection fraction of non-smokers was 34.6% ± 4.0 whereas mitral valve thickness was +9.9% and a decrease of -6.5% in the mitral E_a/A_a. Posterior wall thickness of non-smokers was 14.
Hence the findings suggest that smoking in the presence of diabetes mellitus have increased risk of diabetic cardiomyopathy. Smoking increases hypertension and also leads to dyslipidemia. Moreover, it also hinders in the mitral and tricuspid flow. Therefore, Smoking is the vital factor that stimulates the early onset of diabetic cardiomyopathy.

INTRODUCTION

Diabetes mellitus is a metabolic disorder associated with hyperglycaemia resulting from defective insulin secretion, insulin action or both causing abnormalities in the metabolism of carbohydrates, protein and lipids (Bell et al., 2014). The actual cause of diabetes mellitus is a mystery, although genetic and environmental factors play an important role in its pathogenesis. Studies have shown that occurrence of diabetes is also affected by ethnic and racial differences (Ogedengebe et al., 2014).

Diabetes mellitus is fast becoming pandemic. Increased incidence of diabetes mellitus is a result of several factors such as population growth, urbanization, aging, calorie rich diet, physical inactivity and obesity (Milardi *et al*., 2014). According to the World Health Organization (WHO) fact sheet issued in 2009, more than 220 million people worldwide have diabetes. In 2005, an estimated 1.1 million people died from diabetes, which is predicted to double in 2030 (WHO, 2009).

The National Diabetes Data Group (NDDG) classified diabetes mellitus into four subtypes (American Diabetes Association, 1979). Type 1 diabetes mellitus, is also known as insulin dependent diabetes mellitus (IDDM) and is an autoimmune disorder characterized by destruction of beta cells of pancreas. Type 1 diabetes mellitus is also characterized by the presence of auto-antibodies against islet cells and insulin. Type 1 accounts for 5% to 10% of people suffering from diabetes. Patient suffering from this type of diabetes require insulin for survival. Type 2 diabetes mellitus, is also known as non-insulin dependent diabetes mellitus (NIDDM) and is the most prevalent type of diabetes accounting for 90 to 95 % of diabetic patients. Type 2 is characterized by disorders in insulin secretion or insulin resistance or both. Individuals suffering from type 2 are usually obese and often do not require insulin for survival (Almeida-Pititto 2015).

Gestational diabetes mellitus (GDM) is a hyperglycaemic condition first recognized or appears during pregnancy (Kuzuya *et al.*, 2002). In some cases, it can be controlled by change in diet while in other instances insulin is required to control this condition. Gestational diabetes affects around 4% of pregnancies in the USA. It is responsible for 90% of 24 pregnancy complications associated with diabetes. In most cases of GDM, the hyperglycaemia resolves soon after the delivery of infant (Agarwal *et al.*, 2005).

Other forms of diabetes are secondary to other conditions such as genetic defects, endocrinopathies, some drugs, environmental factors, metabolic events and infections (Almeida-Pititto 2015).

Diabetic complications associated with diabetes mellitus are mainly responsible for mortality and morbidity in diabetic patients. Diabetes and its complications have a significant economic impact on individuals, families, health systems and countries (WHO, 2011).

Hyperglycaemia is associated with a variety of symptoms such as polyuria, polydipsia, weight loss, polyphagia and blurred vision (Bell et al., 2014). Clinical trials carried out by the Diabetes Control and Complications Trial (DCCT) and United Kingdom Prospective Diabetes Study (UKPDS) have established a strong correlation between hyperglycaemia and diabetic complications. Effective control of blood glucose levels significantly delayed the onset and progression of diabetic complications.

Acute life-threatening diabetic complications involve hyperglycaemia with ketoacidosis or non-ketonic hyperosmolar syndrome. However, persistent chronic hyperglycaemia is responsible for majority of long-term complications i.e. diabetic cardiomyopathy. The biochemical pathways associated with chronic hyperglycaemia and tissue damage are not completely understood.

Almost all the tissues of the body are affected by diabetes leading to organ dysfunction which ultimately results in diabetes related morbidity and mortality. Among the well-known risk factors of heart failure is diabetes. The heart of diabetic patients is affected in three ways: 1) Coronary artery disease, (2) Cardiac autonomic neuropathy (3) Diabetic cardiomyopathy (Pappachan *et al*., 2013)

Cardiovascular disorders linked with diabetes have been a subject of interest for the past several years. Clinically Diabetic cardiomyopathy has been defined as the presence of myocardial dysfunction in diabetic patients without the occurrence of any other cardiovascular complication, such as coronary artery disease (CAD), hypertension (HTN) etc (Pappachan et al., 2013, Battiprolu at al., 2013). In research the earliest manifestation of DCM has been found such as left ventricular hypertrophy and diastolic dysfunction and the pathologic factors linked to DCM includes myocardial lipid overload, altered substrate utilization, oxidative stress, fibrosis, inflammation, and mitochondrial dysfunction (Schilling and Mann, 2012). In this study, the risk for the development of DCM in smokers versus non-smokers has been determined.

Smoking has been placed on the 4th position of global threats. Tobacco smoking is the most effective habit and induces altered behavior in humans. Tobacco is also termed as the second major cause of mortality (Gamit et al., 2013). The risk factors responsible for cardiovascular diseases also include cigarette smoking which modifies the severity of disorder and plays major role in the early onset of cardiovascular diseases. The manifestations associated with smoking are changes in blood lipoprotein concentration, high serum cholesterol level, coronary vasomotor activity and platelet aggregation (Prasad et al. 2009). The risk of myocardial infarction increases 1 – 3 folds among cigarette smokers (Gamit et al., 2013). It is also considered as a dominant risk factor for diabetes and arterial hypertension (Fagard, 2009). In this study the effect of smoking on anthropometric indices, blood pressure, pulse rate, FPG and lipid profile is evaluated.

METHODOLOGY

This study was carried out during March 2024 to December 2024. It included 150 males among which 75 smokers and 75 non-smokers of 40-70 years of age from National Institute of Cardiovascular disease, Karachi. People from different socio background and different ethnicity were randomly selected for this study.

Study Design: Cross sectional study

Sample Size Calculation: The sample size was calculated for the study by using the total number of

Population Interest: This study was carried out in human subjects

Sample Technique: It was a convenient sampling technique

Data Collection: A questionnaire, consisting of six parts, was distributed among 150 males for collection of data as per the requirement of study.

Anthropometric Measurement: Anthropometric measurements are non-invasive, quantitative measurement of human body including weight, height, circumferences and skinfold thickness which is used to assess body size, shape and composition. During the study different measurements was taken in order to evaluate the nutritional and health status, helpful for monitoring health risks associated with body composition. Measurement of body mass index (BMI) and Waist to Hip Ratio (WHR) was recorded of each participant under standard guidelines.

Blood Pressure Measurement: There are two methods to measure blood pressure. In this study the indirect method to measure arterial blood pressure was adopted and that is auscultatory method. The two sounds are termed as systolic and diastolic which are the upper pressure and lower pressure respectively. The pulse pressure is calculated by the difference between systolic and diastolic pressure.

Blood Sample Collection: Diagnostic approach for the adults as recommended by WHO and PMDC, was followed to screen the subject including total cholesterol, HDL, LDL and triglycerides and fasting plasma glucose. Specimens were collected at National Institute of Cardiovascular Disease. The participants were requested to provide consent for blood test for FPG and lipid profile. All blood samples were collected in heparinised tube. A total of 2.5 ml of blood was taken from each patient and control. Within 1 hour of collection the blood was centrifuged and the plasma was separated. The blood was centrifuged at 4000rpm and the plasma was separated and kept in Eppendorf tube for the analysis of total cholesterol, triglyceride, HDL, LDL and fasting plasma glucose (FPG). FPG was estimated by TRINDER method and lipid profile was measured by Global Enzymatic Endpoint test and Randox kit. (Lieberman and Burchurd, 1885)

Data Analysis: Standardized statistical programs including test of significance, regression analysis of coefficient and correlation was applied to correlate various parameters among different groups. Data was analyzed on SPSS. The mean and standard deviation of all the quantitative parameters including BMI, WHR, BF%, BP, pulse rate, FPG and lipid profile were computed and for qualitative parameters count and percentage table was made using frequency distribution table. The histogram graphs and mean graph were also made and included in the results.

The association and comparison of qualitative parameters between diabetic smokers and non-smokers were evaluated using Pearson chi-square test while independent t-test was run to analyses the mean of all quantitative parameters of smokers and non-smokers. Spearman rank correlation was used to find out the correlation among variables, then Binary logistic analysis was performed to estimate the odds of increasing FPG, total cholesterol, triglyceride, HDL and LDL in smokers with respect to non-smokers. Univariate and Multivariate analysis provide the estimated odds with 95% C.I adjusted with age. All statistical tests were performed after checking the normality of the data at 5% level of significance and P-value less than 0.05 was considered as the evidence of statistical significance.

RESULTS

All of the subjects under study were between 40 to 60 years of age with a mean of 55.6 years. 150 candidates were selected and were divided into two groups; non-smokers and smokers. 50% were non-smokers and 50% were smokers. BMI was found to be 23.33 in overall population. The overall mean value of anthropometry, vitals, FPG and lipid profile are given in the table 01. As discussed in methodology there are two types of parameters quantitative and qualitative. The qualitative parameters include sign and symptoms of diabetic cardiomyopathy, medical history, sedentary life style, eating habits and stress. The quantitative parameters include anthropometric indices (BMI,

WHR, Body fat %), blood pressure and pulse rate and Blood test (fasting plasma glucose, total cholesterol, triglyceride, HDL and LDL). The quantitative as well as qualitative parameters were compared between non-smokers and smokers.

Age and Anthropometric Indices: Table 01 shows comparison, mean along with standard deviation in the overall data. The participants belong to age above 50 were more in the study while participants at age below 50 remained less in number. The mean BMI of smokers was found to be 23.77 whereas the mean BMI of non-smokers was 22.89. More participants of our study show BMI ranging from 22 to 23 while BMI 27 was found in few of the participants. The mean WH ratio in non-smokers was 0.83 whereas the mean WHR in smokers was 0.85. Maximum participants of the study show WHR 0.86 while a smaller number of the participants shows WHR of 0.88. The data presented percent body fats with mean value of 24.63. Most of the participants were having 23 percent body fats while few subjects have 27% body fats.

Blood Pressure and Pulse Rate: The mean systolic blood pressure in non-smokers was found to be 114.66 whereas in smokers the mean value was 131.46. It was observed that maximum of the subjects' systolic blood pressure is 120 mmHg while few participants had 70 mmHg. The mean value of diastolic blood pressure in non-smokers was 84.26 mmHg whereas in smokers the mean value was 82.53mmHg. The maximum number of the participants had 70 mmHg of diastolic blood pressure while few of the participants showed diastolic blood pressure to be 60 mmHg. The mean value for Pulse rate of non-smokers was 87.38 whereas for non-smokers the mean value was found to be 110.05. The value found frequently in the overall data was 80 while 115 pulse rates was found in less participants.

Fasting Plasma Glucose: The mean value of FPG in overall data was 222.13 with the standard deviation of 95.51mg/dl. In non-smokers the mean value was found to be 217.96 whereas in smokers the value was 226.30. The minimum value in the overall data was found to be 77 mg/dl while the maximum value found remained 200 mg/dl (fig 08).

Lipid Profile: The overall mean value was calculated to be 153.13 with the standard deviation of 22.97. The mean value of total cholesterol found in smokers was 168.04 whereas in non-smokers was 138.22. The maximum value found in the overall study was 140 while the minimum value found was 210 (fig 09).

Triglyceride was found with the mean value of 143.20 in non-smokers whereas 170.85 in smokers. The overall mean value was calculated as 157.02 with the standard deviation of 24.92 Most of the participant had triglyceride 145 while the extreme value 225 was found in fewer patients (fig 10).

The total mean value of HDL found in the study was 38.18 with the standard deviation of 14.10. In non-smokers the mean value was 48.45 whereas in smokers 27.90 mg/dl was found to be the mean. The maximum value found in the participants was 25 while the minimum value found remained to be 65mg/dl (fig 11).

The mean value in the overall data was calculated to be 111.06 mg/dl with the standard deviation of 33.27. The mean value of LDL in non-smokers was 84.80 mg/dl whereas in smokers the mean value was found to be 137.33 mg/dl. The value of LDL that was frequently observed in the participants was 80 mg/dl while a smaller number of patients had LDL value of 50mg/dl (fig 12).

Table 01: Smokers and Non-smokers Comparison of Anthropometric indices, Blood pressure, Fasting plasma glucose and lipid profile

Parameters	Group	N	Mean	Std. Deviation	P value
Body mass index	Non-smokers	75	22.8933	2.18677	0.025*
	Smokers	75	23.7720	2.54710	
Waist to Hip ratio	Non-smokers	75	.8399	.03209	0.018*
	Smokers	75	.8509	.02399	
Body fat percentage	Non-smokers	75	24.4524	2.38424	0.503
	Smokers	75	24.8245	4.16752	
Systolic blood pressure	Non-smokers	75	114.6667	17.80778	0.000*
	Smokers	75	131.4667	32.41177	
Diastolic blood pressure	Non-smokers	75	84.2667	15.61127	0.468
	Smokers	75	82.5333	13.46601	
Pulse Rate	Non-smokers	75	87.3867	18.42728	0.000*
	Smokers	75	110.0533	25.23827	
Fasting Plasma Glucose	Non-smokers	75	217.9600	103.89970	0.594
	Smokers	75	226.3067	86.82103	
Total Cholesterol	Non-smokers	75	138.2267	15.20364	0.000*
	Smokers	75	168.0467	19.52842	
Triglyceride	Non-smokers	75	143.2000	19.27188	0.000*
	Smokers	75	170.8533	22.17236	
High density lipoprotein	Non-smokers	75	48.4533	12.10014	0.000*
	Smokers	75	27.9067	6.32706	
Low density lipoprotein	Non-smokers	75	84.8000	22.35524	0.000*
	Smokers	75	137.3333	18.20182	
AGE	Non-smokers	75	57.1867	7.07812	0.028*
	Smokers	75	54.0800	9.82517	

*P-value < 0.05 is considered as significant using independent t-test.

Comparison in Diabetic Cardiomyopathy Sign and Symptoms:

Using Pearson chi-square test of independence, the diabetic cardiomyopathy sign and symptoms such as breathing trouble, chest Pain, swelling of abdomen, indigestion, chest congestion and cough, swelling of legs and feet and fatigue shows a significant difference between the case and control with the p-value of <0.01. In non-smokers 81.3% showed breathing trouble. 94.7% were observed with chest pain, 57.3% with swelling of abdomen, 70.7% with indigestion, 37.3% with chest congestion and cough, 5.3% with swelling of legs and feet and 98.7% with fatigue.

100 % of Smokers showed the following symptoms breathing trouble, chest pain and swelling of abdomen and fatigue while 62.7% of smokers were observed with indigestion, 37.3% with chest congestion and cough, 26.7% with swelling of legs and feet. Case control comparison is given in the table 03.

Comparison in Medical History, Exercise and Stress

Table 02 shows that the patients of diabetic cardiomyopathy who used to smoke were under more stress than non-smokers and were not able to manage their stress properly using Pearson chi-square test of independence with p-value of <0.01. Sedentary life style and less physical activity were found in both smokers and non-smokers. The medical history was obtained from non-smokers, which revealed that 54.7% of subjects had diabetes for 1to 5 years while 20% were suffering for 6 to 10 years and 21.3% subjects for 11 to 20 years whereas 48% smokers had diabetes for 6 to 10 years while 25.3% for 1 to 5 years and 26.7% of smokers had diabetes for 11 to 20 years. 21.3% of non-smokers used to take insulin while 78.7% used to take hypoglycaemic agents to control the blood glucose level and only 44% of non-smokers had controlled blood glucose level whereas 57.3% of smokers had controlled blood glucose level with 10.7%

used to take insulin while 89.3% were having hypoglycaemic agent. Family history of diabetes shows a significant difference in non-smokers and smokers with p-value of 0.003. Smokers were asked about the duration of smoking and 27% smokers have been smoking for 21 to 30 years while only 7% have been smoking for more than 30 years.

Comparison of Anthropometry, BP, FPG and Lipid profile:

Anthropometric indices show a significant difference in case and control with p-value of <0.01. BMI, WHR and body fat percent were found to be more in smokers as compared to non-smokers. Systolic blood pressure and pulse rate were increased in smokers whereas diastolic blood pressure was found to be increased in non-smokers. FPG was higher in smokers.

Figure 1 show comparison in total cholesterol, triglyceride, HDL and LDL. Total cholesterol, triglyceride and LDL levels were found higher in diabetic smokers as compared to diabetic non-smokers while HDL levels were observed lower in smokers than non-smokers. The comparison among the parameters is shown in table 01.

Table 02: Sign and Symptoms in Smokers and Non-Smokers

SYMPTOMS	YES	Non-Smokers		Smokers		P-value
		N	%	n	%	
Breathing trouble	Yes	61	81.3	75	100	0.000*
Chest Pain	Yes	71	94.7	75	100	0.120
Swelling of abdomen	Yes	43	57.3	75	100	0.000*
Indigestion	Yes	53	70.7	47	62.7	0.387
Chest congestion and cough	Yes	28	37.3	28	37.3	1.000
Swelling of legs and feet	Yes	4	5.3	20	26.7	0.001*
Fatigue	Yes	74	98.7	75	100	1.000

*P-value < 0.05 is considered as significant using independent t-test.

Table 03: Comparison of Characteristics of Diabetic Smokers and Non-smokers

Characteristics		Non-smokers		Smokers		P-value
		N	%	n	%	
Duration of diabetes	1-5 years	41	54.7	19	25.3	
	6-10 years	15	20.0	36	48.0	
	11-20 years	16	21.3	20	26.7	
	>20 years	3	4.0	0	0.0	
Controlled blood glucose level	Yes	33	44	43	57.3	0.141
Type of medication	Insulin	16	21.3	8	10.7	
	Hypoglycemic agent	59	78.7	67	89.3	
Family history of diabetes	Yes	53	70.7	68	90.7	0.003*
Exercise	Yes	27	36	24	32	0.730
Stress	Yes	41	30.75	63	47.25	
Duration of smoking	5-10 years	0	0	10	13.3	
	11-20 years	0	0	22	16.5	
	21-30 years	0	0	36	27	
	>30 years	0	0	07	9	

*P-value < 0.05 is considered as significant using independent t-test.

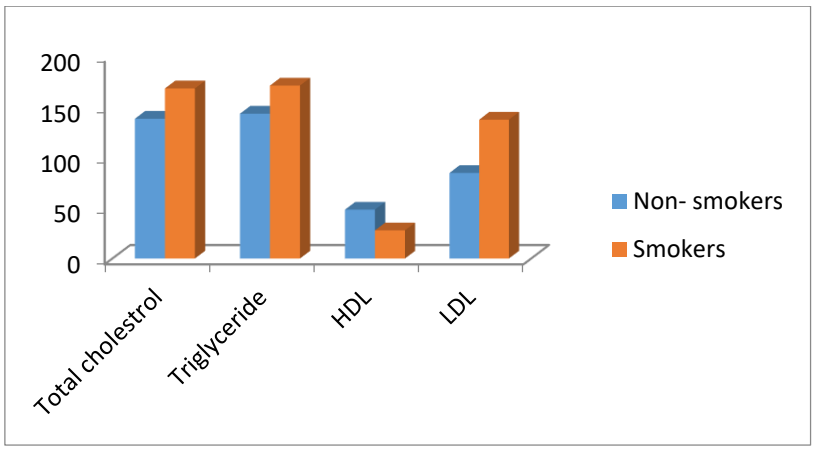

Figure 01: Comparison of lipid profile between smokers and non-smokers

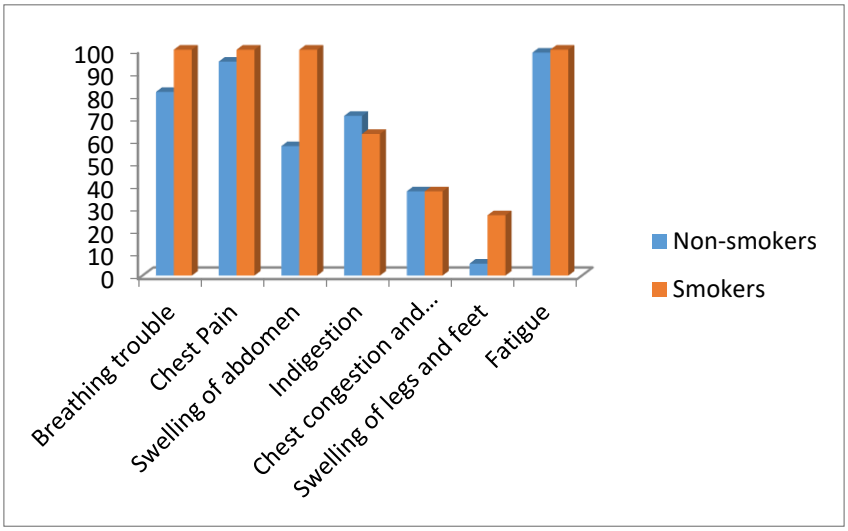

Figure 02: Comparison of symptoms between smokers and non-smokers

Correlation between Age, Anthropometry, blood pressure and pulse rate:

There is negative correlation between age and body fat percentage (r=0.405, p=0.000). Body mass index show correlation with body fat percentage (r=0.825, p=0.000), systolic blood pressure (r=0.243, p=0.003), diastolic blood pressure (r= -0.554, p=0.000), since there is a negative correlation between BMI and diastolic BP which means that if BMI increases the diastolic BP decreases. WHR shows correlation with systolic BP (r=0.528, p=0.000), diastolic BP (r=0.495, p=0.000). Body fat percentage shows correlation with BMI (r=0.825, p=0.000), systolic BP (r=0.208, p=0.011). The negative correlation exists between BF% and Diastolic BP (r= -0.374, p=0.000) and pulse rate (r= -0.313, p=0.000).

Systolic BP shows positive correlation with BMI (r=0.243, p=0.003), WHR (r=0.528, p=0.000), BF% (r=0.208, p=0.011), diastolic BP (r=0.198, p=0.015) and pulse rate (r=0.271, p=0.001). The negative correlation exists between diastolic BP and BMI (r= -0.554, p=0.000), diastolic BP and BF% (r= -0.374, p=0.000). The positive correlation exists between Diastolic BP and WHR (r=0.495, p=0.000), systolic BP (r=0.198, p=0.015) and pulse rate (r=0.179, p=0.029). Pulse rate shows negative correlation with BF% (r= -0.313, p=0.000) and shows positive correlation with systolic BP (r-0.271, p=0.001) and with diastolic BP (r=0.179, p=0.029).

Correlation between Lipid profile, anthropometry and blood pressure:

The positive correlation exists between total cholesterol and systolic blood pressure (r=0.284, p=0.000), pulse rate (r-0.244, p=0.003), triglyceride (r=0.966, p=0.000) and LDL (r=0.942, p=0.000). The negative correlation is found between total cholesterol and HDL (r= -0.617, p=0.000). Triglyceride shows correlation with systolic blood

pressure (r=0.246, p=0.002), pulse rate (r=0.187, p=0.022), total cholesterol (r= 0.966, p=0.000) and LDL (r=0.870, p=0.000) but shows negative correlation with HDL (r= -0.581, p=0.000).
HDL shows negative correlation with systolic BP (r= -0.250, p=0.002), pulse rate (r= -0.263, p=0.001), total cholesterol (r= -0.617, p=0.000), triglyceride (r= -0.581, p=0.000) and LDL (r= -0.759, p=0.000). LDL shows positive correlation with BMI (r= 0.175, p=0.032), systolic blood pressure (r=0.294, p=0.000), pulse rate (r=0.274, p=0.001), total cholesterol (r= 0.942, p=0.000) and triglyceride (r= 0.870, p=0.000) but LDL has negative correlation with HDL (r= -0.759, p=0.000).

DISCUSSION:

Over the past decade there has been considerable interest in diabetes mellitus and its associated complications. DCM is the complication of long-term diabetes mellitus but it has not been well recognized. It is significantly associated with cardiac morbidity and mortality. (Pappachan *et al.*, 2013) The impaired insulin signalling has severe effects in destructing numerous tissues including the cardiovascular system (Battiprolu at al., 2012). The heart is at increased risk of having ischemic heart disease and cardiomyopathy which could lead to heart failure (Patil and Burji., 2012). The rate of deaths from heart disease is 2-4 times more in diabetic adults as compared to non-diabetic adults (Isfort et al., 2014).
In the present study three anthropometric indices were evaluated; BMI, WHR and body fat percentage. The mean BMI of smokers was found to be 23.77 ± 2.5 kg/m^2 which is greater than BMI of non-smokers i.e. 22.89 ± 2.1 kg/m^2. The subjects are overweight and obesity is an important risk factor for the development of diabetes mellitus. The study conducted by Krause et al., 2007 confirmed the direct relation between general and central obesity with type II DM. The mean WHR of smokers was calculated to be 0.85 ± 0.02 and WHR of non-smokers was 0.839 ± 0.03. This high WHR shows that subjects have apple obesity. A study was conducted in 2006 in USA in which relationship of body size and shape to the development of diabetes was studied and it was concluded the large waist circumference contributes in the development of diabetes mellitus. Body fat percentage has not been much assessed by researchers. Thus, it proves that high BMI, WHR and body fat percentage contribute to the onset of DM and can also worse the condition of diabetes. These factors along with smoking also play major role in development of DCM. Obesity has been linked to the development of coronary heart disease in presence of diabetes (Yamamoto-Honda et al., 2013). In contrast to the previous study, present study showed that all three anthropometric indices of smokers were significantly higher than non-smokers. This finding may be due to the sedentary lifestyle of smoker as they all had breathing problems and were not able to work for longer hours. The anthropometric indices also show correlation with systolic BP and fasting plasma glucose whereas the negative correlation was seen between anthropometric indices and diastolic BP. The odds estimation shows that anthropometric indices are more likely to increase in diabetic smokers than non-smokers.
In accordance with the previous study (karakaya et al., 2006), this study showed that Systolic blood pressure and pulse rate of smokers were significantly higher than that of non-smokers. The mean systolic BP of smokers was 131.46 ± 32.41 and the pulse rate was found to be 110.05± 25.23 while the diastolic BP did not show any significant difference. The systolic BP and pulse rate showed significant difference with p-value 0.000 of both. The pulse rate significantly increased after smoking in the study conducted by Karakaya et al., 2006. High blood pressure contributes to the cardiovascular abnormality caused by diabetes (Palmieri et al., 2001). Takayuki et al., 2013 observed in his study that the incidence of impaired systolic LV function was less in diabetes than diastolic dysfunction. The mean diastolic BP in smokers was found to be 82.53± 13.46. Diastolic dysfunction was found to be associated with uncontrolled

diabetes. It was also found to be common in patients taking hypoglycaemic agents and insulin to maintain their blood glucose level. Diastolic dysfunction depends on duration of disease, glycaemic level and type of treatments (Patil and Burji, 2012). However, in this study patients did not show any significant difference in diastolic blood pressure which may be due to the fact that they were on medications to control blood pressure and blood glucose level. Systolic BP and pulse rate show positive correlation with anthropometric indices, total cholesterol, triglyceride and LDL. However diastolic BP shows positive correlation with FPG. The odds were estimated and smokers were more likely to increase systolic BP and pulse rate

The echocardiography reports of all of the patients were collected and mean ejection fraction of diabetic smokers was found to be 29.1% ± 6.0. The increased in left ventricular mass was also detected. Posterior wall thickness was found to be 18. The ejection fraction of non-smokers was 34.6% ± 4.0 while Posterior wall thickness of non-smokers was 14. Cigarette smoking is an important factor that brings considerable changes in the hemodynamics of heart. Increase in blood pressure and heart rate is directly caused by smoking. Smoking was also linked to severe impaired LV function. Doppler echocardiography of smokers revealed increased mitral valve thickness, decreased mitral E_a/A_a (Giacomin et al., 2008). In a study carried out by Mohammad and Hasmi., 2013, 40% diabetic patients had < 30% ejection fraction.

Blood samples of both smokers and non-smokers were collected to find blood glucose level and lipid profile. The samples were taken in fasting condition to get the accurate results. There was no significant difference found in FPG of smokers and non-smokers. The mean FPG of smokers was 226.30 ± 86.82 mg/dl. Hyperglycemia has been linked to the cause of myocardial necrosis and fibrosis (Seferovic et al., 2012). The fasting plasma glucose was also found to have association with the occurrence of hypertension in the study conducted by Janghorbani et al., 2015. The impaired fasting glycemia is the most common metabolic abnormality in patients of type II DM which is further followed by elevated levels of blood cholesterol, triglyceride and LDL and reduced HDL level (Ogedengebe and Ezeani., 2014) FPG is more likely to increase in smokers and it also shows correlation with age, body fat percentage and diastolic BP.

The lipid profile of smokers showed significant difference from that of non-smokers with p-value of 0.000 each. The mean total cholesterol, triglyceride, HDL and LDL of smokers were found to be 168.04± 19.52, 170.85± 22.17, 27.90± 6.32, 137.33± 18.20 respectively. Stamouli et al., 2014 conducted a study to evaluate lipid profile in diabetic patients and found total cholesterol, triglyceride and LDL to be elevated while HDL levels were found lower. The cause of the abnormal lipid profile was found to be hyperglycaemia (Janghorbani et al., 2015). The impaired glucose tolerance also showed abnormal lipid profile (Kawamori., 1996). In another study elevated LDL was found to be an important factor in the development of coronary artery disease (Daniel., 2011). Total cholesterol, triglyceride and LDL were more likely to increase in smokers than non-smokers. These parameters also exhibit correlation with systolic BP and pulse rate while diastolic BP exhibits positive correlation with HDL. Hyperglycemia and hyperlipidemia are considered as the main metabolic impairments which further play role in generation of reactive oxygen or nitrogen species leading to diabetic cardiomyopathy (Kritikos et al., 2014).

The present study also compared symptoms of diabetic cardiomyopathy between smokers and non-smokers. The first symptom was breathing trouble and all of the smokers showed this symptom whereas 81.3% non-smokers had breathing trouble. The second symptom was chest pain which was observed in all smokers and 94.7% non-smokers. Another symptom which was asked from the patients was swelling of abdomen which was also observed in all he smokers while only 57.3% non-smokers showed this sign. Indigestion was observed in 62.7% smokers while 70.7% were non-smokers who were suffering from indigestion whereas chest congestion and cough was present in both subjects equally with p-value 1.000. The other symptoms swelling of

legs and feet were found in 5.3% non-smokers and 26.7% smokers. 98.7% non-smokers while 100% smokers showed fatigue to be another symptom. A study conducted by Seferovic et al., 2012 mentioned dyspnea, arrhythmias, atypical chest pain and dizziness as the symptoms of diabetic cardiomyopathy.

In the present study some characteristics of smokers and non-smokers were also compared. The first question was asked from all the subjects about duration of their diabetes. 48.0% smokers had diabetes for 6-10 years whereas 54.7% non-smokers had diabetes for 1-5 years. 21.3% non-smokers while 26.7% smokers have been diabetic for 11-20 years. Long term hyperglycemia is the leading cause of DCM (Mandavia et al., 2012).

The participants were asked about their blood glucose level 57.3% smokers had controlled blood glucose level while only 44% non-smokers answered affirmatively for the control of blood glucose level. The uncontrolled plasma glucose level is the leading cause of diastolic dysfunction (Patil and Burji, 2012). Most of the patients have controlled blood glucose level because of medications. Furthermore, they were asked about the type of medication to control the increasing blood glucose level was also asked 21.3% non-smokers used to take insulin while 78.7% used to take hypoglycemic agents to maintain the blood glucose level. Majority of the smokers i.e. 89.3% were taking hypoglycemic agents and only 10.7% were taking insulin to reduce their elevated blood glucose level. Another characteristic that was asked was their family history for diabetes. 90.7% smokers while 70.7% non-smokers had positive family history for diabetes. The family history for diabetes mellitus shows the significant difference between smokers and non-smokers with p-value of 0.003. It is a well-known fact that diabetes run in family, it is inherited from parents to their offspring. Similarly, if precautions for diabetes are not taken it is difficult to prevent the development of DCM.

Patients were asked random questions to predict their life style. Most of the surveyed population showed no interest in outdoor activities and accepted the fact that they were leading an inactive life. 32% smokers used to do exercise while 36% non-smokers were regular exercise doers. Living a sedentary life style is an important risk factor for the development of diabetes and cardiovascular disorder. Krause et al., 2007 in his study found that elderly women who exercise regularly had lower odds for type II DM. The researchers also mentioned that regular exercise practice is helpful in decreasing body fatness and minimizing the risk for the onset of type II DM.

Stress is another important factor which affects the quality of life, the question for stress was also asked. Most of the subjects negated the fact that they were under stress they were not very comfortable with the idea of sharing their personal problems but after assuring them that we had no bad intention and asking them about different aspects of their life we found that 47.25% smokers whereas 30.75% non-smokers had stress in their life.

The subjects were also asked for the time period they have been smoking and it was estimated that 27% smokers have been smoking for 21 to 30 years, 13.3% for 5-10 years and 16.5% for 11to 20 years while only 9% have been smoking for more than 30 years. Karakaya et al., 2006 mentioned in his study that acute and chronic smoking both affect the anatomy and physiology of heart producing impaired right and left ventricular diastolic function. Moreover, cigarette smoking has also been termed as an important risk factor for cardiovascular disease. The risk of sudden death due to myocardial infarction is also higher in smokers as compared to non-smokers (Esen et al., 2004).

With the help of this study we have found that smoking produces devastating effects in the body of diabetic patients. Smoking worsens the complications of diabetes. The first thing noticeable was high anthropometric indices that along with smoking increased the risk of diabetic cardiomyopathy. Furthermore, the blood pressure and lipid profile are also altered due to smoking. People should be given awareness to cease smoking and to maintain blood glucose level in order to prevent the worsening of diabetic manifestations. The subjects also had habit of taking unbalanced diet which mostly

consists of oil and beef meat. Therefore, some important measures should be taken to minimize the risk of developing DCM.

CONCLUSION

This study highlights that smoking increases blood pressure, pulse rate, total cholesterol, triglyceride, LDL and decreases HDL. Smokers also have high BMI. It has been described that there is a direct relationship of obesity, hypertension, hyperglycemia and hyperlipidemia with DCM. Beside anthropometric indices and other parameters, duration of diabetes, duration of smoking, uncontrolled blood glucose level, type of medication to maintain plasma glucose level, stress, sedentary life style and eating habit were directly linked to DCM

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