# FREQUENCY OF SMOKING AND ITS RELATIONSHIP TO ISCHEMIC HEART DISEASE IN SAUDI MALE DIABETIC PATIENTS

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## ABSTRACT

***Objectives:*** *1) To find out the frequency of smoking in Saudi diabetic patients and to know the frequency of ischemic heart disease (IHD) in regular smoker, ex-smoker and non-smoker diabetic subjects.*

*2): To evaluate and compare the glycemic and lipid control between diabetic smokers and diabetic non-smokers.*

***Methodology:*** *This cross sectional study was conducted at department of Physiology and Medicine, College of Medicine, King Saud University. A total of 1000 Saudi diabetic patients (509 Males & 491 females) were studied. They were evaluated for the presence of IHD and cardiovascular risk factors. Smoking was defined as current regular cigarette smoking or ex-smoking without regard to daily consumption.*

***Results:*** *The frequency of regular smokers in males was 6.87% (n=35), ex-smokers was 6.09% (n=31) and overall it was found to be 12.97% (n=66). Only 2 females were found to be smokers (0.20%). Therefore, only male subjects were studied. The ex-smokers and all smokers had higher body mass index than non-smokers (p<0.05). Smokers had poor glycemic control compared to non-smokers (p<0.05). Triglyceride levels were higher in ex-smokers and all smokers compared to never smokers (p<0.05). Prevalence of IHD in non smokers was 13.77%. In regular smokers and ex-smokers frequency of IHD was 22.58 and 24.24% respectively. Odds ratio of IHD in smokers was 2 (p<0.05).*

***Conclusions:*** *The frequency of smoking in Saudi diabetic patients is 12.97%. Diabetic smokers have poor glycemic and lipid control than non-smokers. Smoking doubles the risk of IHD in diabetes mellitus. Frequency of IHD is similar between regular and ex-smokers.*

***Key Words:*** *Smoking, Diabetes Mellitus, Dyslipidemia, Ischemic Heart Disease*

## INTRODUCTION

There is a high risk of cardiovascular disease (CVD) in people with diabetes mellitus, but an interactive effect of cigarette smoking greatly increases this risk. A substantial number of cardiovascular deaths in diabetes are due to interaction between cigarette smoking and diabetes.[1,2]

National Health Interview Survey of United States (NHIS) 1989 showed that the age-adjusted prevalence of smoking was similar in people with diabetes (27.3% smokers) and without diabetes (25.9% smokers).[3]

A large body of evidence from epidemiological, case control, and cohort studies provides convincing docu-

mentation of the causal link between cigarette smoking and health risks. Much of the prior work documenting the impact of smoking on health did not separately discuss results on subsets of individuals with diabetes, suggesting that the identified risks are at least equivalent to those found in the general population. Other studies of individuals with diabetes consistently found a heightened risk of morbidity and premature death associated with the development of macrovascular complications among smokers. Smoking is also related to the premature development of microvascular complications of diabetes and may have a role in the development of type 2 diabetes.

Prevalence of smoking (34.4%) is high in Saudi Arabia. The same study reported proportion of ex-smokers to be 16.4%[4] In Saudi health workers the prevalence of regular smoking was 19% and of ex-smoking was 14%.[5] There is little information available on the distribution of cigarette smoking in people with diabetes.[6] There are no reported data on prevalence of smoking in Saudi diabetic patients.

Cigarette smoking is one of the leading risk factor for CVD and it is the most important modifiable cause of premature death in diabetics. Patients with diabetes who are smokers are at double risk. Unfortunately, many patients continue to smoke despite having diabetes; for these

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patients, the benefits that can be derived from modifying other risk factors are markedly decreased.[7]

This study was conducted to find out the frequency of smoking in Saudi diabetic male patients and to know the frequency of ischemic heart disease (IHD) in regular smoker, ex-smoker and non-smoker diabetic subjects. Our secondary objective was to evaluate and compare the glycemic and lipid control between diabetic smokers and diabetic non-smokers?

## METHODOLOGY

This cross sectional study was conducted in the department of Physiology and Medicine, King Khalid University Hospital of King Saud University, Riyadh. The study was approved by college of medicine institutional review board. We selected 1000 (509 male and 491 female) subjects by simple randomization diabetic patients from January 2007 to December 2009.

Selection criteria included diagnosed cases of DM having duration of diabetes for at least one year, Saudi national, either sex and age older than 20 years. There was no specific exclusion criteria except those patients who did not complete the investigations needed for this study. Among 1000 patients, only 2 females turned out to be smokers (0.2 %) therefore we excluded female subjects from analysis and analyzed the data only for male. Selected patient were booked in specialized research clinic for full history and examination by a trained physician. The patients were then subjected to cardiac evaluation.

Demographic data including age, sex, height, weight, were collected in addition to diabetes history which included type of diabetes mellitus, duration, family history, and the diabetes management. Each patient was also evaluated for the presence of IHD, risk factors like smoking, hypertension, hyperlipidemia; symptoms suggestive of IHD were also evaluated. Smoking was defined as current regular cigarette smoking or ex-smoking without regard to daily consumption.

Physical examination included height, weight, systolic blood pressure (SBP), diastolic blood pressure (DBP) and also heart auscultation. Fasting venous blood samples were analyzed for fasting blood sugar (FBS), 2 hour post prandial (2hPP), glycosylated haemoglobin (HbA1c), total cholesterol (TC) and triglyceride (TG), high density lipoprotein cholesterol (HDL-C) & low density lipoprotein cholesterol (LDL-C) were also tested. Electrocardiogram (ECG), echocardiogram and stress ECG were done. Cardiac catheterization was also done when the index of suspension was very high. Body mass index (BMI) was calculated by the following formula;

BMI = Body Weight in Kilograms / Height in meters$^2$

Diagnosis of cases for IHD was based on History, resting and stress induced Electrocardiographic findings, Doppler studies, Holter monitor findings, Echocardiography and Cardiac catheterization. The smoking habits of the studied subjects were correlated with glycaemic status, lipid profile, IHD and other complications.

## DATA ANALYSIS

The data was analyzed by Statistical Package for Social Sciences (SPSS Version 10). Descriptive characteristics and lipid profile of the study patients were calculated as Mean ± SD (Standard Deviation) for continuous variables and as percentages for categorical variables. We first compared 4 groups for different characteristics never smokers, current smokers, ex-smokers and all diabetics. We also combined ex and regular smokers for analysis and compared the responses of this combined group with never smokers. Clinical characteristics, glycemic status and lipid profile was compared between different groups by ANOVA. Categorical variables were compared between various groups using Chi square test. A p value of ≤ 0.05 was taken as statistically significant. Odds ratio was calculated at 95 % confidence limits.

## RESULTS

One thousand adult patients with diabetes mellitus (509 Males & 491 females) were selected randomly from the total of 7000 registered patients. Only 2 females were found to be smokers (0.20 %). One female was current smoker and the other was ex smoker. Therefore, we excluded the females from the study and only male subjects were studied. After excluding the females 509 male subjects were left. The frequency of regular smokers in males was 6.87 % (n=35), ex-smokers was 6.09 % (n=31) and overall it was found to be 12.97% (n=66). Clinical characteristics, glycemic status and lipid profile of all diabetic patients are expressed in Table 1. Table II shows comparison of clinical characteristics and glycemic status between non-smokers, regular smokers, ex-smokers and all smokers (regular smokers plus ex smokers). We observed that smokers had poor glycemic control as compared to non smokers (p < 0.05). The ex-smokers and all smokers had higher body mass index (BMI) as compared to never smokers (p < 0.05). Regular smokers had a higher BMI values than non smokers but the difference was non significant. Resting pulse rate was significantly higher in regular smokers and all smokers compared to non smokers (p < 0.05). Other characteristics were similar between all the groups. Table III shows Comparison of lipid profile between non smokers, regular smokers, ex smokers and all smokers (regular plus ex-smokers). Triglyceride levels were observed to be higher in ex smokers and all smokers as compared to never smokers (p < 0.05). While the difference for total cholesterol (TC), low density lipoprotein (LDL) and high density lipoprotein (HDL) levels was non-significant.

We also compared the diabetes related morbidity in non smokers and smokers (Table IV). It was observed that frequency of IHD in non smokers was 13.77 % and smokers prevalence was 24.24 % respectively with an odds ratio of IHD in smokers was 2.0039 (CI; 1.022-3.893,

p=0.042). Comparison of IHD frequency in regular with ex-smokers was non-significant (Table V).

### CLINICAL CHARACTERISTICS, GLYCEMIC STATUS AND LIPID PROFILE OF ALL DIABETIC PATIENTS

| CLINICAL CHARACTERISTICS | All DIABETIC PATIENTS (Mean ± SD) |
|---|---|
| Age (years) | 54.51 ± 11.23 |
| Ht (cm) | 165.58 ± 10.62 |
| Wt (kg) | 76.84 ± 14.18 |
| BMI ( kg/ m2 ) | 27.90 ± 4.96 |
| Pulse (per min) | 81.24 ± 35.57 |
| SBP (mmHg) | 136.10 ± 22.31 |
| DBP (mmHg) | 81.93 ± 10.82 |
| FPG (mmol/l) | 10.39 ± 5.81 |
| 2 Hours PP | 14.55 ± 5.37 |
| HbA1c % | 9.00 ± 3.02 |
| TC (mmol/L) | 5.26 ± 1.04 |
| TG (mmol/L) | 1.78 ± 1.01 |
| LDL (mmol/L) | 3.19 ± 1.26 |
| HDL (mmol/L) | 1.07 ± 0.84 |

Table I

**BMI:** Body mass index; **SBP:** Systolic blood pressure; **DBP:** Diastolic Blood pressure; **FPG:** Fasting plasma glucose; **2 Hours PP:** 2 hours post prandial; **HbA1c:** Glycosylated hemoglobin

## DISCUSSION

Smoking and obesity are leading causes of death worldwide. While smoking is an important risk factor for heart disease and atherosclerosis, the effect of smoking on IHD among diabetic patients has not been thoroughly investigated. Our study shows a high prevalence of IHD and cardiac autonomic neuropathy in diabetic smokers as compared to non smokers. When we compared prevalence of IHD between regular and ex smokers no significant difference was observed. It may indicate that cessation of smoking does not reduce cardiovascular risk substantially in diabetics. Moreover, smoking may be causing some irreversible changes in coronary and peripheral vasculature that are causing IHD, showing that some complex mechanisms are involved. Possibly athero-sclerosis takes longer time to reverse even with treatment. In addition this excess risk may be due to certain non traditional risk factors related to dyslipidemic, pro-inflam-matory and prothrombotic states in diabetic subjects. More prospective studies are needed to elucidate these mechanisms. Another important consideration should be public education and awareness for stopping smoking at primary level of prevention. The data available on smoking prevalence from different parts of the world especially from Western Countries is of both males and females combined and shows a higher prevalence than our population.[8] In Saudi female diabetic subjects prevalence of smoking is very less or almost negligible (0.2 %). In Norfolk study 12 % men and 11 % women were reported to be smokers in a large sample of 2704 men and 3385 women. Smoking affected glucose homeostasis significantly. There was no

### COMPARISON OF CLINICAL CHARACTERISTICS AND GLYCEMIC STATUS BETWEEN NON SMOKERS, REGULAR SMOKERS, EX SMOKERS AND ALL SMOKERS (REGULAR PLUS EX SMOKERS) $

| | Never Smokers (n=443) | Regular Smokers (n=35) | Ex Smokers (n=31) | All Smokers (n=66) |
|---|---|---|---|---|
| Age (years) | 50.38 ± 11.33 | 51.47 ± 11.46 | 52.87 ± 9.18 | 52.39 ± 10.38 |
| Height | 165.38 ± 10.95 | 79.04 ± 13.72 | 166.65 ± 8.58 | 166.37 ± 8.10 |
| Weight | 79.04 ± 13.72 | 75.65 ± 14.79 | 83.92 ± 18.06 | 80.17 ± 16.69 |
| BMI ( kg/ m2 ) | 27.70 ± 4.89* | 28.51± 5.19 | 29.76 ± 5.56 | 29.27 ± 5.35 |
| Pulse (per min) | 78.00 ± 15.00# | 84.00 ± 16.91 | 80.13 ± 8.59 | 83.29 ± 9.95 |
| SBP (mmHg) | 141.38 ± 22.85 | 134.24 ± 22.58 | 134.39 ± 12.68 | 135.69 ± 18.43 |
| DBP (mmHg) | 87.38 ± 10.85 | 82.86 ± 13.62 | 82.13 ± 5.62 | 83.42 ± 10.58 |
| FPG (mmol/l) | 9.86 ± 5.92 | 10.61 ± 5.37 | 10.92 ± 4.64 | 10.59 ± 5.01 |
| 2 Hours PP | 12.21 ± 5.32 | 15.17 ± 5.79 | 14.35 ± 5.75 | 14.38 ± 5.72 |
| HbA1c % | 8.00 ± 2.01@ | 9.26 ± 2.01 | 9.12 ± 1.96 | 9.19 ± 1.98 |

Table II

**$ Data is expressed as Mean ± SD and Differences were studied by ANOVA**
**\* p < 0.05 versus Ex and All Smokers**
**# p < 0.05 versus Regular and All Smokers**
**@ p < 0.05 versus All Smokers**
**BMI:** Body mass index; **SBP:** Systolic blood pressure; **DBP:** Diastolic Blood pressure; **FPG:** Fasting plasma glucose; **2 Hours PP:** 2 hours post prandial; **HbA1c:** Glycosylated hemoglobin

**COMPARISON OF LIPID PROFILE BETWEEN NON SMOKERS, REGULAR SMOKERS, EX SMOKERS AND ALL SMOKERS (REGULAR PLUS EX SMOKERS)$**

| mmol/L | Never Smokers | Regular Smokers (n=35) | Ex Smokers (n=31) | All Smokers (n=66) |
|--------|---------------|------------------------|-------------------|---------------------|
| TC | 5.44 ± 0.98 | 5.18 ± 1.25 | 5.15 ± 1.19 | 5.09 ± 1.38 |
| TG | 1.30 ± 1.01* | 1.92 ± 1.11 | 2.13 ± 1.16 | 2.04 ± 1.13 |
| LDL | 3.86 ± 1.26 | 3.14 ± 1.05 | 3.49 ± 1.50 | 3.36 ± 1.29 |
| HDL | 1.27 ± 0.77 | 0.99 ± 0.33 | 1.25 ± 1.61 | 1.12 ± 1.17 |

Table III

**$ Data is expressed as Mean ± SD and Differences were studied by ANOVA * $p < 0.05$ versus Ex and All Smokers**
**TC:** Total cholesterol; **TG:** Triglycerides; **LDL:** Low density Lipoprotein; **HDL:** High density lipoprotein

**DIABETES-RELATED MORBIDITY IN RELATION TO SMOKING STATUS IN NON SMOKERS AND SMOKERS$**

| | Non Smokers (n=443) | Smokers (n=66) | P value | Odds ratio | 95 % Conf. Limits |
|--|---------------------|----------------|---------|------------|---------------------|
| IHD | 61 (13.77) | 16 (24.24) | 0.042 | 2.00 | 1.022-3.893 |
| Hypertension | 110 (24.83) | 22 (33.33) | 0.186 | 1.51 | 0.836-2.726 |
| Chest Pain | 59 (13.31) | 10 (15.15) | 0.831 | 1.16 | 0.524-2.514 |
| SOB | 52 (11.73) | 10 (15.15) | 0.555 | 1.34 | 0.602-2.925 |
| Palpitations | 36 (8.12) | 6 (9.09) | 0.979 | 1.13 | 0.408-2.958 |
| Claudication | 43 (9.7) | 8 (12.12) | 0.696 | 1.28 | 0.527-3.015 |
| Cold Extremities | 39 (8.80) | 9 (13.63) | 0.304 | 1.63 | 0.696-3.740 |
| Murmurs | 105 (23.70) | 9 (13.63) | 0.094 | 0.50 | 0.226-1.107 |
| Cardiac autonomic Neuropathy | 15 (3.38 ) | 7 (10.60) | 0.017 | 3.38 | 1.193-9.319 |
| Ischemic Changes on ECG | 34 (7.67 ) | 13 (19.69) | 0.165 | 1.89 | 0.800-4.392 |

Table IV

**$ Figures given are frequencies (percent of total). IHD:** Ischemic heart disease, **SOB:** Shortness of breath

**DIABETES-RELATED MORBIDITY IN RELATION TO SMOKING STATUS IN REGULAR AND EX SMOKERS$**

| | Regular Smokers (n=35) | Ex Smoker (n=31) | P value | Odds ratio | 95 % Conf. Limits |
|--|------------------------|------------------|---------|------------|---------------------|
| IHD | 9 (25.71) | 7 (22.58) | 0.99 | 1.11 | 0.333-4.262 |
| Hypertension | 11 (31.42) | 11 (35.48) | 0.93 | 0.833 | 0.264-2.622 |
| Chest Pain | 4 (11.42) | 6 (19.35) | 0.58 | 0.53 | 0.111-2.494 |
| SOB | 6 (17.14) | 4 (12.90) | 0.89 | 1.33 | 0.301-6.744 |
| Palpitations | 4 (11.42) | 2 (6.45) | 0.78 | 1.8 | 0.262-168.086 |
| Claudication | 5 (14.28) | 3 (9.67) | 0.84 | 1.55 | 0.284-133.070 |
| Cold Extremities | 5 (14.28) | 4 (12.90) | 0.84 | 1.10 | 0.228-5.687 |
| Murmers | 5 (14.28) | 4 (12.90) | 0.84 | 1.10 | 0.228-5.687 |
| Cardiac autonomic Neuropathy | 4 (11.42) | 3(9.67) | 0.86 | 1.20 | 0.201-7.575 |
| Ischemic Changes on ECG | 8 (22.85) | 5 (16.12) | 0.70 | 1.54 | 0.385-6.345 |

Table V

**$ Figures given are frequencies (percent of total). IHD:** Ischemic heart disease, **SOB:** Shortness of breath

separate data for diabetic subjects. The data reported for diabetic subjects was based on self reports by patients.[9]

Thomas et al[10] reported significantly higher glycosylated haemoglobin levels in smokers than never smokers. Male smokers compared to never smokers had lower HDL-cholesterol levels and elevated albumin-to-creatinine ratio. However, diastolic blood pressure was lower in the smoking group. The prevalence of peripheral vascular disease was higher in the diabetic patients who smoked compared to nonsmokers. We observed significantly higher levels of triglycerides in smokers compared to never smokers. Similar prevalence of smoking in diabetics (13.9 %) has been reported by Solberg et al[8] There was no difference in glycemic control between smokers and non smokers. In UK 16% diabetics are current smokers, 31% are ex-smokers and 51% are never smokers. People with diabetes who smoke are regarded as a vulnerable group who need more intensive support and treatment.[11] Ruggiero et al[12] found that 58% of 2,056 diabetic smokers were not currently considering giving up smoking. In those who had received advice from their doctor, more were considering giving up smoking. Patients who are ready to give up smoking should be treated using interventions which have been shown to be effective, including nicotine replacement therapy when appropriate. Smoking cessation interventions are considered to be highly cost effective.[13] One study has reported that smokers and nonsmokers do not differ significantly with regard to HbA1c level, BMI, or duration of diabetes mellitus and study suggested that smoking does not have a significant direct effect on BMI or HbA1c in patients with type 2 diabetes mellitus.[14] Smoking has been reported to be associated with both poor glycaemic control and microalbuminuria. Our data support these studies.[15] Smokers had adverse metabolic profile and peripheral vascular disease in a study on Chinese population. These observed effects of smoking alarms for starting effective tobacco control programs to prevent or minimize its potential impacts on health and chronic diseases.[10] Frequency and duration of smoking is associated with higher rates of subclinical atherosclerosis in diabetic subjects.[16]

Although there is minimal information on the effectiveness of cessation interventions specifically for people with diabetes, there is no reason to assume that cessation intervention would be more or less effective in this population. There is a clear need to increase the frequency of smoking cessation advice and counseling for patients with diabetes due to strong and consistent data on smoking prevalence, morbidity, mortality and the proven efficacy and cost-effectiveness of cessation strategies.[17]

The cardiovascular burden of diabetes, especially in combination with smoking, has not been effectively communicated to people with diabetes or to health care providers, and there is little evidence that this risk factor is being addressed as consistently and comprehensively as its importance requires. Smoking is also related to the premature development of microvascular complications of diabetes and may even have a role in the development of type 2 diabetes. All health care providers should advise individuals with diabetes not to initiate smoking. This advice should be consistently repeated to prevent smoking and other tobacco use among children and adolescents with diabetes under age 21 years. Among smokers, cessation counselling must be completed as a routine component of diabetes care. Effectiveness of smoking cessation Counseling is no doubt significant. But it is not clear that this cessation will reduce IHD by how much percentage.[18]

A number of large randomized clinical trials have demonstrated the efficacy and cost-effectiveness of counseling in changing smoking behavior. Such studies, combined with others specific to individuals with diabetes, suggest that smoking cessation counseling is effective in reducing tobacco use.[19,20]

Unfortunately, only less than half of smokers seen by a physician report receiving advice or counseling to quit[21] and even fewer about 2% to 15% are offered any form of assistance, including provision of specific counseling on how to stop, referral to treatment programs, or prescription for smoking cessation medications.[22] A structured intervention managed by a single nurse included counseling, education, and contracting information has shown to be effective in changing the smoking behavior of diabetic patients.[23] Other studies also support benefits of smoking cessation programs.[24,25] However there are studies in which cessation programs were not beneficial.[26,27] According to recent reports of Centers for Disease Control and Prevention it is said that IHD is the leading cause of death for people with diabetes and in adults with diabetes about 68% die of heart disease or stroke and smoking doubles the risk for heart disease in diabetic patients. Our results also confirm these observations.[28] Therefore, routine and thorough assessment of tobacco use is important as a means of preventing smoking or encouraging cessation.

## CONCLUSION

Our study shows that the frequency of smoking in Saudi diabetic patients is 12.97% which is lower than reports from western populations. In female diabetic sub-

jects smoking is negligible. Diabetic smokers have poor glycemic and lipid control than non smokers. Smoking doubles the risk of IHD in diabetes mellitus with a similar prevalence between regular and ex smokers.

We recommend that campaigns against smoking should be aimed at primary level along with secondary levels.

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Following authors have made substantial contributions to the manuscript as under

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