# ASSESSMENT OF THE QUALITY OF CARDIOVASCULAR RISK FACTORS CONTROL IN DIABETIC PATIENTS

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## Abstract

**BACKGROUND:** cardiovascular diseases are prevalent in diabetic patients and have a worse prognosis than patients without diabetes. Its cause is the high incidence of risk factors. In this study, we investigated the quality of control of cardiovascular risk factors in diabetic patients.

**METHOD AND MATERIALS:** In this observational study, 514 cases of diabetes were studied. These cases included 142 males (27.6%) and 372 females (72.4%) referring to diabetes clinic of Kerman medical university from 1999 to 2007. All data were extracted from the patients' profile and entered in the forms. Data were analyzed using SPSS v 11.5.

**RESULTS:** The results showed that the mean age of the subjects was 57.18 (± 10.33) and the mean body mass index was 26.29 (± 4.66) kg/m$^2$.
Based on the first visit, the incidence of obesity, dislipidemia and hypertension was 17.5%, 84.6% and 62.2%, respectively. Of all the subjects, 32.8% had 2 risk factors, 41.40% had 3 and 18.87% had more than 3 risk factors. The frequency of controlled risk factors such as FBS, HbA1C, triglyceride, cholesterol, HDL level more than 40 in males and 50 in females (based on the average of total visits) was 10.1%, 20%.6,57.4%, 38.9%, 39.8%, respectively. The frequency of systolic and diastolic blood pressure of less than 130/80 mmHg was 67.9% and 52.1%.

**CONCLUSION:** This study shows the high prevalence of cardiovascular risk factors in diabetics, the poor control over these factors and points out the importance of diagnostic-therapeutic interventions for a more accurate control over cardiovascular risk factors.

**Keywords:** prevalence, cardiovascular diseases, risk factors, diabetes.

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## Introduction

The most important causes of mortality in different societies are cardiovascular diseases.[1] Several cardiovascular risk factors in community include hypertension, dislipidemia, obesity and smoking;[2] but the risk of cardiovascular diseases is higher in diabetic patients not only due to disorders in metabolism of carbohydrates and lipids, but also because of the higher prevalence of risk factors in this population. This causes the complications of cardiovascular diseases to be four times more in diabetic population. Also, diabetics are susceptible to cardiovascular complications earlier in life and those complications tend to have poorer prognosis compared to those in non-diabetics.[3]

Based on the available evidence, a better control of blood sugar and strict treatment of hypertension in diabetics hinder the micro-vascular and macro-vascular complications.[4]

Although recent studies have emphasized on the strict control of blood pressure in diabetics, but the mean blood pressure has not decreased to the desired level in any of them.[5] On the other hand, strict treatment of dislipidemia in diabetics decreases the risk of cardiovascular diseases more than that in non-diabetics.[6]

Various studies have performed in the field of risk factors of cardiovascular diseases in diabetic patients. Canizo et al found that 27% of patients reached the desired level of fasting blood sugar (FBS), 62% reached the desired level of triglyceride (TG), and 27% reached the desired level of systolic blood pressure and 72% reached the desired level of diastolic blood pressure.[7]

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Other studies in Italy and France have shown that most of the diabetics had poor control over cardiovascular risk factors despite the treatments they had received.[8,9]

Studies have also been carried out in Iran in this field showing the high prevalence of risk factors and the poor control over them in diabetic patients.[10-17] In a study by Amini et al,[11] 74.2% f patients had more than 2 risk factors and 48.1% had more than 3 risk factors. Another study by this author in the field of the quality of follow-up and treatment of diabetic patients showed that while 78.3% of patients had dislipidemia and 45% had hypertension at the initial assessment, after one year, 49.2% had dislipidemia and 35% had hypertension, meaning that the state of hypertension had not made any apparent improvement.

Since the cardiovascular risk factors play a significant role in the prognosis of patients and in determining the primary and secondary prevention strategies for cardiovascular diseases, recognizing and controlling them are essential in diabetic patients. Considering the lack of adequate information regarding the state of cardiovascular risk factors and the control over them in diabetic patients in the city of Kerman, this study aimed to assess the quality of control of cardiovascular risk factors in diabetic patients referred to the diabetes clinic of Kerman medical university between 1999 and 2007.

## Materials and Methods

In this cross-sectional study, the medical profile of diabetics, who were referred to the diabetes clinic of the hospitals of Kerman medical university since 1999, were evaluated. Out of 1665 available medical profile, 514 were enrolled in the study. These profiles contained all the information needed for the study and at least 3 visit sessions were registered within them.

Age, sex, body mass index (BMI), history of smoking, diabetes duration, previous or present history of diabetes control, number of visits in the clinic and drugs history were registered from their medical profile. Subjects' weight and height were measured and registered in their initial visit at the clinic.

To evaluate the obesity status of the subject, a BMI less than 25 kg/m$^2$ was considered "normal". A BMI between 25 and 29.9 kg/m$^2$ was considered as "overweight" and a BMI over 30 was considered "obese".

Systolic blood pressure equal or more than 130 mmHg and diastolic blood pressure equal or more than 80 mmHg was considered as high blood pressure. In addition, subjects taking anti-hypertensive drugs were considered to be hypertensive. In case of using anti-dislipidemia agents or a lipid profile with levels higher than the ADA criteria, the subject was considered to have dislipidemia.

Smoking was defined according to WHO guidelines and the term "smoker" was attributed to subjects who smoked at least 1 cigarette per day, regularly. This was first questioned on the initial visit at the clinic.[18]

Blood sample was taken from all the patients after a fasting period of 12 hours. According to ADA, an FBS less than 130 mg/dl, blood suger 2 hours after meal (BS-2hpp) less than 180 mg/dl, TG level less than 150 mg/dl, total cholesterol level less than 200 mg/dl, HDL level more than 40 mg/dl in men and more than 50 mg/dl in women, LDL level less than 100 mg/dl and HbA1C less than 7% were desirable.[19] The information of all studied cases for each year was separately registered. If every patients had more than one lab data or blood pressure registered, the average data was considered. In the mentioned clinics, BMI and smoking status were only registered in patient's first visit.

The data was analyzed by SPSS v. 11.5 using t-test, chi-square test, McNemar and ANOVA. P values less than 0.05 was considered to be statistically significant.

## Results

Out of 514 diabetic patients, 372 (72.4%) were female and 142 (27.6%) were male. The mean age was 57.18 (± 10.33) years. The mean age of onset of diabetes was 50.42 (± 10.77) years and the average disease duration was 6.67 (± 5.98) years. The mean BMI was 26.29 (± 4.66) kg/m$^2$. Of all the patients, 17.5% were obese (14.1% were men and 18.8% were women) and 38.3% were overweight. Totally 8% of patients were smokers. High blood pressure was seen in 62.2% of patients while only 47.8% used anti-hypertension agents. About 84.6% of patients had dislipidemia and only 36.77% took anti-dislipidemia agents. The prevalence of using of anti-hypertension and anti-dislipidemia agents was higher in women.

Of all the patients, 32.8% had 2, 41.4% had 3 and 18.87% had more than 3 cardiovascular risk factors. The mean FBS and BS-2hpp levels were 181.74 (± 46.35) and 260.85 (± 79.08) mg/dl, respectively. The mean LDL and HDL levels were 129.197 (± 35.96) and 46.67 (± 1.37) mg/dl, respectively.

The mean TG and cholesterol levels were 202.239 (± 86.85) and 213.193 (± 42.37) mg/dl, respectively. The mean systolic and diastolic blood pressures were 125.012 (± 13.51) and 78.84 (11.150) mmHg, respectively. The mean $HbA_1C$ was 8.57% (± 1.97%).

The quantitative variables showed no significant statistical differences in their mean value between the two genders of diabetic patients (Table 1).

**Table 1.** Comparison of the mean values of quantitative variables in the two genders in diabetic patients

| Variables | Male (n = 142) | Female (372) | t-test result (p) |
|---|---|---|---|
| BMI* | 25.81 ± 4.09 | 26.47 ± 4.86 | 1.15 |
| Duration of disease | 6.56 ± 6.17 | 6.84 ± 5.92 | 0.63 |
| FBS (mg/dl) | 180.62 ± 43.45 | 182.16 ± 47.46 | 0.73 |
| BS $_{2hpp}$ (mg/dl) | 261.49 ± 86.6 | 260.59 ± 76.33 | 0.91 |
| HbA1C** (%) | 8.72 ± 1.88 | 8.51 ± 2.006 | 0.43 |
| Cholesterol (mg/dl) | 212.24 ± 30.87 | 213.55 ± 46.06 | 0.75 |
| LDL-C*** (mg/dl) | 129.79 ± 27.52 | 128.97 ± 38.74 | 0.81 |
| HDL-C**** (mg/dl) | 42.96 ± 9.72 | 48.00 ± 34.93 | 0.09 |
| Triglyceride (mg/dl) | 197.77 ± 79.79 | 205.32 ± 79.79 | 0.37 |
| Systolic blood pressure (mmHg) | 125.92 ± 11.06 | 124.67 ± 14.33 | 0.34 |
| Diastolic blood pressure (mmHg) | 78.53 ± 5.58 | 78.97 ± 12.65 | 0.69 |

*BMI: body mass index
**$HbA_1C$: glycosilated hemoglobin
***LDL_c: low_density lipoprotein cholesterol
****HDL_c: high_density lipoprotein cholesterol

**Table 2.** Comparison of controlled risk factors in the two genders among the diabetic patients

| **Variables** | **Male (n=142)** | **Female (372)** | **Chi-square result (p)** |
|---|---|---|---|
| BMI less than 25 $kg/m^2$ | 47.2% | 43% | 0.4 |
| FBS less than 130 mg/dl | 14.1% | 8.6% | 0.04 |
| BS-2hpp less than 180 mg/dl | 20.6% | 15.7% | 0.22 |
| HbA1C less than 7% | 17.1% | 21.9% | 0.41 |
| Cholesterol less than 200 mg/dl | 36.6% | 39.7% | 0.54 |
| LDL less than 100 mg/dl | 11.5% | 20.7% | 0.01 |
| HDL more than 40 mg/dl in males and more than 50 mg/dl in women | 63.1% | 30.8% | 0.00 |
| Triglyceride less than 150 mg/dl | 57.7% | 57.3% | 0.99 |
| Systolic blood pressure less than 130 mmHg | 62% | 70.2% | 0.09 |
| Diastolic blood pressure less than 80 mmHg | 45.8% | 54.6% | 0.07 |

Controlled cases are defined based on ADA criteria for blood suger, lipid profile, blood pressure and BMI.

**Table 3.** Comparison of controlled risk factors in patients' first and last visits

| **Variables** | **First visit (%)** | **Last visit (%)** | **McNemar result (P)** |
|---|---|---|---|
| FBS less than 130 mg/dl | 17.3 | 23.8 | 0.008 |
| BS $_{2hpp}$ less than 180 mg/dl | 21.3 | 19.1 | 0.32 |
| HbA1C less than 7% | 21.1 | 24 | 0.24 |
| Cholesterol less than 200 mg/dl | 40.6 | 47.7 | 0.008 |
| LDL less than 100 mg/dl | 21.4 | 28.7 | 0.001 |
| HDL more than 40 mg/dl in males and more than 50 mg/dl in women | 38.6 | 35.6 | 0.27 |
| Systolic blood pressure less than 130 mmHg | 58.8 | 56.6 | 0.37 |
| Diastolic blood pressure less than 80 mmHg | 32.7 | 27.2 | 0.85 |

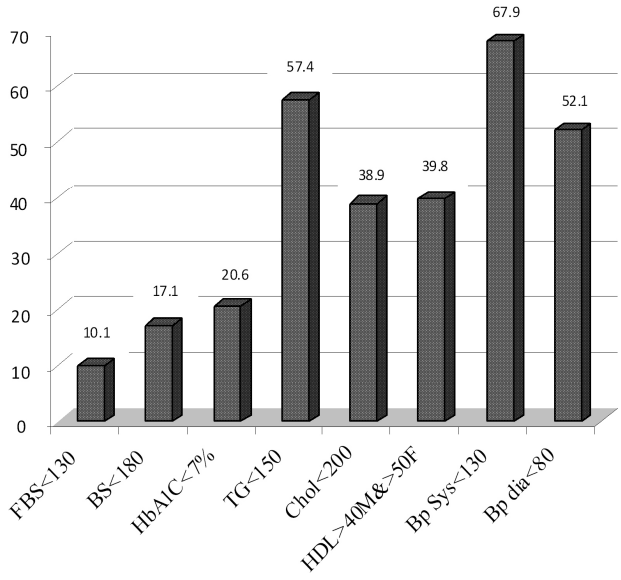


**Figure 1.** The frequency of controlled cardiovascular risk factors based on the average prevalence in clinic visits of diabetic patients

LDL levels were controlled better in women. FBS and HDL levels were more controlled in men. These differences were statistically significant ($P < 0.05$) (Table 2).

The frequency of well-controlled cases showed significant difference only in FBS, cholesterol, LDL and TG levels, in a comparison between the first and the last visits ($P < 0.05$) (Table 3).

The mean FBS, cholesterol, LDL and TG levels in subjects' last visit in the clinic were significantly decreased, but the average of other risk factors did not decrease significantly. The mean of the quantitative variables of this study was compared with each other based on the treatment approach and the duration of disease, which did not show any significant differences overall.

## Discussion

Our results showed that blood lipoprotein level is not controlled in more than 3/4 of patients; this alone can pose as a risk factor in individuals with high blood sugar levels. Results from this study suggest that dyslipidemia is a major factor causing atherosclerosis in diabetic patients. Overall, more than 80% of subjects had two or more cardiovascular risk factors. The frequency of controlled risk factors suggested that only the systolic and diastolic blood pressures and the triglyceride level had reached the desired values in more than 50% of cases.

In a study by Weerasuriya et al in Srilanka on diabetic patients,[21] hypercholesterolemia and high LDL-c levels were reported in 11% and 12% of patients, respectively, which has a lower prevalence compared to our study; considering that the mean age of subjects was lower in that study (42.3 ± 6.2).

The low prevalence of hyperlipidemia seems to be associated with diet and religious beliefs in terms of not having meat with the meals.

In another study on diabetic subjects by Cathelineau et al in France,[22] hypercholesterolemia was reported in 44.6% of patients with a mean level of 228 ± 44 mg/dl. In this study, 38.8% of patients had hypertension which had a lower prevalence compared to our study. The mean cholesterol level and the mean BMI were higher compared to those in our study.

In the UK prospective diabetes study, the lipid profile has been reported in diabetic patients as follows. The total cholesterol level was 223.3 ± 46.2 mg/dl and 211.8 ± 42.3 mg/dl in women and men, respectively. The LDL-c level was 150.9 ± 42.5 mg/dl and 139.3 ± 47.6 mg/dl in women and men, respectively. The HDL-c level was 40.3 ± 8.4 mg/dl in this population, which was higher in women compared to that in men. There was no difference in TG level between the two genders.[23]

In the current study, the mean lipid levels were not different between the two genders (Table 1). Genetic factors, diets and eating habits, type of activities, cultural and economic factors may have been the cause of diverse results in different countries. The state of being obese or overweight is another risk factor with high prevalence in our study.

More than half of the subjects were overweight or obese in our study. In a study by Azizi et al[24] on newly-diagnosed diabetic patients who were detected by glucose tolerance test in Tehran's population, 44% of patients were overweight and 45% were obese. These percentages were higher than ours which might be due to the fact that our patients were more aware about their weight control because of their long duration of disease. In the West, the prevalence of obesity has been reported higher than that of our study, the mean BMI was reported to be 30.1 ± 6.2 kg/m$^2$ in diabetic patients.[25]

The newly-diagnosed diabetic patients from Srilanka.[21] were obese in 16% of cases. This result was much closer to ours which may be due to cultural and economic matters. The prevalence of hypertension was 62.2% in aforementioned study.

The prevalence of hypertension was 18% in Isfahan's population in a study by Sarrafzadegan et al[26] and it was 22% in Tehran's population (ages between 20-69 years) in a study by Azizi et al.[27] Compared to the two studies mentioned above, the prevalence of hypertension in our study is higher than society which

may be due to our target population – a population in which the risk of hypertension is inevitably high. Compared to the studies performed on diabetic populations, the prevalence of hypertension in our study is higher than that in the studies carried out in the West. In the study by Weerasuriya, the prevalence of hypertension was 23% and in a study performed on French population, it was 38.8%.[22]

In the study by Amini et al,[11] the prevalence of hypertension was reported to be 28.6% which is lower than our study. The reason of this difference may be due to the longer disease duration of our subjects compared to that study. Amini et al study was performed within one year and several controlled risk factors might have probably got out of control or vice versa, several uncontrolled factors might have come into a controlled desirable range in the following years. Therefore the results may not show the patients' real follow-up outcome. On the contrary, in our study, the subjects were followed for 3 years and had at least 3 visits in our clinic during this period, which will contribute to more precise results regarding our subjects' follow-up outcome.

On the other hand, 58.8% of the subjects had a systolic blood pressure of less than 130 mmHg on their first visit and 56.6% of them had so on their last visit; 32.7% of subjects had a diastolic blood pressure of less than 80 mmHg on their first visit and 27.2% of them had so on their last visit. This implies that comparing subjects' blood pressure on the first and the last visits, not only has it not decreased, but it has also increased. Considering that 62.2% of subjects had hypertension and only 47.8% of them took anti-hypertension drugs and the majority of them were not using any agents to optimize their blood pressure, such results are not far from imagination.

In general, it can be concluded that the blood pressure control is not paid enough attention in our society despite its major role in decreasing the morbidity and mortality rates in diabetic patients. Thus, more studies are essential to evaluate the main reasons why appropriate drug therapy doesn't begin for most of the diabetic patients with hypertension (factors pertaining the physician, medicine expenses etc.), why enough dosage of medicine is not used or the drug dosage is not changed in uncontrolled blood pressures. More studies are needed to assess the type of anti-hypertensive drugs used in treatment of patients and to compare their efficacy in controlling hypertension, so that the hypertensive status of these patients is controlled while the existing deficiencies are recognized with proper planning. In a study by Canizo- Gomez,[7] the subjects who had received anti-diabetes drugs had lower $HbA_1C$ levels which might be due to their 2-hour post-prandial blood suger level. Such results were not found in our study which may be due to the fact that $HbA_1C$ levels were not registered in all of our patients' profile, making this one of the limitations of our study.

In the current study, the mean FBS, cholesterol, LDL and TG levels in the last visit in the clinic indicated a significant decrease compared to those on the first visit. The frequency of controlled cases showed a significant increase only in regard to the FBS, LDL, cholesterol and TG levels, according to ADA criteria. Thus, it can be concluded that the treatment given for the control of the FBS, LDL, cholesterol, and TG levels was appropriate. Sex, age, treatment protocol and disease duration did not have any significant association with the main variables of our study.

Considering that the cardiovascular risk factors were not properly controlled in these patients, it is suggested that future studies focus on why our goals were not achieved regarding these variables, so that along with removing such problems, the follow-up status and treatment approaches of diabetic patients improve in future.

## Conclusion

The presence of a significant frequency of cardiovascular risk factors in diabetic patients indicates the utmost importance of primary prevention. Control of diabetes and early diagnosis and treatment of the risk factors using efficient and practical strategies to change the quality of life must be one of country's top priorities.

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