Dietary and Health-Related Lifestyle Habits and Blood Parameters of Non-Insulin Dependent Diabetes Patients

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Controlling dietary behaviors and health-related lifestyle habits is important to manage non-insulin dependent diabetes mellitus (NIDDM). If NIDDM is not treated properly, the prevalence of macro-vascular complications (MC) may increase. The goal of NIDDM therapy is to maintain normal concentrations of blood glucose and lipid profiles by having regular meals, controlling alcohol drinking, quitting smoking, and performing physical exercise regularly. This study was performed to investigate the dietary and health-related lifestyle habits and blood parameters of NIDDM patients of both genders and compared these characteristics between the patients with and without MC. Our results show that the subjects with MC compared to without MC and the female patients than the males controlled their diets more regularly, tended to regulate the number of meals better, and smoke less than those without MC. Although plasma lipid profiles were not significantly different between the genders and between the subjects with and without MC, the men had higher blood glucose and plasma tHcy concentrations than the women and plasma tHcy concentration was higher in the female subjects without MC. These results imply that the male patients of NIDDM without MC might have more problems in maintaining their blood glucose. In addition, smoking may be the most important life-style factor influencing some blood parameters like blood glucose, HbA1c, and total cholesterol in the NIDDM patients.

Key Words: Diabetes, Dietary habits, Health-related lifestyle habits, Smoking

INTRODUCTION

The prevalence of non-insulin dependent diabetes mellitus (NIDDM) has increased rapidly over the past decades in Korea. This might be due to the change in dietary and health-related lifestyle habits, such as high energy intake from animal fat, excess alcohol drinking, smoking, and sedentary life. To treat NIDDM, it is important to maintain proper diets and health-related lifestyles.[1]

The effects of alcohol on blood glucose, plasma lipids, and plasma total homocysteine (tHcy) in NIDDM patients depend on the amount of alcohol consumed.[2,3] Alcohol is not harmful and, in fact, may be beneficial if it is consumed moderately, no more than 2 drinks per day in addition to the usual meal plan.[2] Plasma tHcy may decrease with moderate alcohol intake,[5] but in contrast, a dramatic increase in plasma tHcy appeared with high alcohol intake.[3] There is a controversy regarding the effects of smoking on plasma tHcy: It was reported that hyperhomocysteinemia with smoking and hypertension accelerated to form blood plaques in diabetes patients[5] and thus, smoking was associated with

hyperhomocysteinemia.[6] However, there was no difference in plasma tHcy concentrations between smokers and non-smokers in Korea.[7] The positive effect of regular exercise on blood glucose concentration has been well established: Exercise enhances the sensitivity of insulin action, which may help the utilization of blood glucose in muscle.[8]

In NIDDM patients, the development of vascular abnormalities, especially macro-vascular complications (MC), are major causes of mortality.[9] The risk factors in MC are hypercholesterolemia, hypertriglycemia, and hyperhomocysteinemia, which are concurrent with diabetes. It is widely accepted that plasma tHcy is an independent risk factor in atherosclerosis.[10] However, there are still arguments as to whether or not plasma tHcy is also one of the risk factors in atherosclerosis of NIDDM patients.[11,12] Moreover, there is little information about dietary and health-related lifestyle habits in NIDDM patients with and without MC.

Therefore, we investigated the dietary and health-related lifestyle habits and blood parameters of NIDDM patients of both genders and compared these characteristics between the patients with and without MC.

METHODS

1. Subjects

A total of 80 subjects (30 men and 50 women) diagnosed with NIDDM and hospitalized in a hospital in Gwangju participated voluntarily in this study with written consents.

General characteristics of the subjects, age, education level, occupation, family type, and family history of NIDDM, were collected by interview with a questionnaire. Current body weights were measured and the weights before the onset of NIDDM were orally reported. Systolic and diastolic blood pressures were measured. The existence of MC, cerebral, coronary, and renal artery sclerosis and hypertension was ascertained from their medical charts. The subjects were divided into one of the four groups according to gender and the existence of MC.

2. Dietary and Health-Related Lifestyle Habits

The questionnaire about dietary habits included the amount and number of meals per day, the number of snacks per day, food preferences, and the degree of appetite. Also, the concerns about nutrition and the person who prepared meals were asked. Health-related lifestyle habits were composed of alcohol drinking, smoking, the perception of exercise, and the strength and frequency of exercise.

3. Blood Sampling and Biochemical Assessment

Fasting peripheral blood was collected by venipuncture into centrifuge tubes containing heparin. Whole blood was centrifuged to obtain plasma at 3,000 rpm for 15 min at 4 °C. Plasma samples were stored at -70 °C untill they were analysed. Plasma concentrations of glucose, triglyceride (TG), total cholesterol (T-C), HDL-cholesterol (HDL-C), and free fatty acids (FFA) were analyzed by a Hematology Analyzer (Hitachi 7060, Japan). HbA1c and tHcy concentrations were measured using a Hematology Analyzer (IMX, USA) with micro-particle enzyme immunoassay kit (Astx-shield Co., Norway) and fluorescence polarization immunoassay kit (Abbott Co., USA), respectively.

4. Statistical Analysis

All data were analyzed by using the SAS. Differences in the frequency and distribution of variables of general characteristics, dietary habits, and health-related lifestyle habits between the gender groups and between the groups with MC and without MC were assessed by the Chi-square test. A t-test was used to ascertain the differences in blood parameters and blood pressures. Blood parameters between smokers and non-smokers, between drinkers and non-drinkers, and between exercisers and non-exercisers were also compared by a t-test. A p-value<0.05 was chosen as the level of significance.

RESULTS

1. General Characteristics

General characteristics of the subjects according to gender and presence of MC are presented in Table 1. The female subjects tended to be older than the male subjects, but not significant. The half of the men were below 60 years of age, whereas only 10% of the women were. Education level of the men was significantly higher (p<0.01) than that of the women; over two thirds of the men had graduated from senior high schools, but in the women, over half had completed only elementary school and one third had not received any formal education. The percentage of the subjects employed was higher (p<0.01) in the men than in the women. Almost 37%

Table 1. General characteristics of the subjects according to gender and MC existence

Variables	Men			Women		
	W/ MC (n=19)	W/O MC (n=11)	Total (n=30)	W/ MC (n=33)	W/O MC (n=17)	Total (n=50)
Age (yrs)	63.4±7.7	60.2±14.2	61.9±10.8	69.8±7.2	68.6±6.7	69.7±7.3
Education level (yrs)***	9.6±4.1	9.8± 3.0	9.7±3.7	5.1±3.1	4.2±3.5	4.8±3.8
Occupation (%)**						
Employed	36.9	36.4	36.7	9.1	5.8	8.0
Unemployed	63.1	63.6	63.3	90.9	94.2	92.0
Family type (%)						
Alone or with spouse	52.6	54.5	53.3	72.7	82.4	76.0
With other family members	47.4	45.5	46.7	27.3	17.6	24.0
Family history of NIDDM (%)						
Yes	9.1	21.1	16.7	41.2	21.2	28.0
No	90.9	78.9	83.3	58.8	78.8	72.0

Values are means±standard deviations or the percentages of subjects.
There were no significant differences between with and without MC groups in each gender group.
The variables are significantly different between gender groups by the Chi-square test (**p<0.01, ***p<0.001).
NIDDM; non-insulin dependent diabetes mellitus, MC; macro-vascular complications

of the men had jobs, however, while only 8% of the women were employed. As for family types, approximately the half of the men lived with their sons or daughters, but the three fourths of the women lived alone or with their spouse. It is considered generally that women can do the household matters including cooking. However, as considering that most women in the study were pretty old, there might be some problems with food purchasing and meal preparation. The percentage of total subjects who had family history of NIDDM was 23.8%. It seemed to be lower than the data, 34.2%, determined by Park *et al.*.[13] There were no differences in these general characteristics between the subjects with and without MC in both genders.

2. Dietary Habits

Dietary habits of the subjects by gender and MC existence are shown in Table 2. As for the number of meals per day, most subjects had three meals a day and 10.5% of the men with MC consumed two meals a day. However, 18.2% of the men without MC and 11.8% of

the women without MC did not keep their meal numbers regular. This result indicates that the subjects without MC tend not to control their diets as strictly as those with MC. There was also a significant difference (p<0.05) in the amount of foods eaten between female subjects with and without MC. There have been no previous data about the meal regularity of NIDDM patients with MC. However, the results of this study show that the subjects with MC may be on controlled diets in contrast to those without MC. Below 60% of the men and over 70% of the women had snacks, but there were no significant differences in the number of snacks per day between genders and the subjects with and without MC. The women tended to have poor appetites compared with the men and also the male subjects with MC, compared to those without MC, were likely to have poor appetites. The subjects with MC in both genders showed a tendency to prefer meat in contrast to those without MC. And the men tended to like meat more than the women.

Nutritional concerns that all subjects had related to the

Table 2. Dietary habits of the subjects according to gender and MC existence

Variables	Men			Women		
	W/ MC (n=19)	W/O MC (n=11)	Total (n=30)	W/ MC (n=33)	W/O MC (n=17)	Total (n=50)
Number of meals per day						
2	10.5	0.0	6.7	0.0	0.0	0.0
3	84.2	81.8	83.3	100.0	88.2	96.0
Uncertain	5.3	18.2	10.0	0.0	11.8	4.0
Amount of meals*						
Consistent	47.4	54.5	50.0	57.6	23.5	46.0
Intermediate	31.6	18.2	26.7	36.3	47.1	40.0
Not consistent	21.0	27.3	23.3	6.1	29.4	14.0
Number of snacks per day						
0	36.8	54.5	43.3	27.3	29.4	28.0
1-2	47.4	27.3	40.0	60.6	70.6	64.0
≥3	15.8	18.2	16.7	12.1	0.0	8.0
Appetite						
Poor	10.5	0.0	6.7	12.1	11.8	12.0
Fair	42.1	27.3	36.7	51.5	58.8	54.0
Good	47.4	72.7	56.6	36.4	29.4	34.0
Food preference						
Animal	26.3	0.0	16.7	12.1	11.8	12.0
Intermediate	47.4	90.9	63.3	27.3	3.3	30.0
Vegetable	26.3	9.1	20.0	60.6	52.9	58.0
Nutritional concerns						
Sweets	68.4	54.5	63.3	57.6	94.1	70.0
Fat or Cholesterol	10.6	9.1	10.0	12.2	0.0	8.0
Calorie	5.2	9.1	6.7	6.1	5.9	6.0
Salt	5.2	0.0	3.3	3.0	0.0	2.0
Fiber	0.0	0.0	0.0	3.0	0.0	2.0
None	10.6	27.3	16.7	18.1	0.0	12.0
Person preparing meals						
Self	89.8	90.9	90.0	72.7	64.7	70.0
Others	10.5	9.1	10.0	27.3	35.3	30.0

Values are the percentages of subjects.
The variable is significantly different between with and without MC groups only in the women by the Chi-square test (*p<0.05)
There were no significant differences between gender groups.
MC; macro-vascular complications

consumption of sweeteners including sugar. They were also concerned about the intakes of fat or cholesterol, calories, salt, and dietary fiber. The percentage of the subjects who prepared their meals by themselves was 90% in the men and 70% in the women.

3. Health-Related Lifestyle Habits

Health-related lifestyle habits according to gender and existence of MC are presented in Table 3. A large number of subjects quit drinking alcohol after being

Table 3. Health-related habits of the subjects according to gender and MC existence

Variables	Men			Women		
	W/MC (n=19)	W/O MC (n=11)	Total (n=30)	W/ MC (n=33)	W/O MC (n=17)	Total (n=50)
Alcohol drinking***						
Current	31.6	54.5	40.0	12.1	0.0	8.0
Past	31.6	27.3	30.0	21.2	5.9	16.0
Never	36.8	18.2	30.0	66.7	94.1	76.0
Smoking***,*						
Current	15.8	63.6	33.3	3.0	5.9	4.0
Past	36.8	18.2	30.0	18.1	17.6	18.0
Never	47.4	18.2	36.7	78.9	76.5	78.0
Perception of exercise						
Weak	47.4	54.5	50.0	45.5	64.7	52..0
Moderate	36.8	45.5	40.0	45.5	29.4	40.0
Strong	15.8	0.0	10.0	9.0	5.9	8.0
Exercise frequency						
≤ 1/wk	47.4	45.5	46.6	51.5	59.0	54.0
2-4/wk	31.6	45.4	36.7	18.2	17.6	18.0
≥ 5/wk	21.0	9.1	16.7	30.3	23.5	28.0
Exercise strength						
Light(walking, running)	89.5	81.8	86.7	90.9	100.0	94.0
Moderate(ping-pong, cycling)	10.5	9.1	10.0	0.0	0.0	0.0
Heavy(swimming, golf, bowling)	0.0	9.1	3.3	9.1	0.0	6.0

Values are the percentages of subjects.
The variables are significantly different between gender groups by the Chi-square test (***p<0.001).
The variable is significantly different between with and without MC groups only in the men by the Chi-square test (*p<0.05)
MC; macro-vascular complications

diagnosed with NIDDM. However, in the men, over half of the subjects without MC and one third of those with MC continued to consume alcoholic beverages. Even in the women, more than one tenth with MC kept drinking alcohol. A considerable number of the subjects continued to smoke although there were some subjects who gave up smoking after being diagnosed. Two thirds of the male subjects without MC (p<0.05) did not quit smoking. There were more smokers (p<0.01) and more drinkers (p<0.01) among the men than among the women. This result means that the NIDDM patients with MC were more likely to quit smoking than the patients without MC. In both genders, half of the subjects had a weak perception of exercise, and actually half of them never or rarely exercised. Only 16.7% of the men and 28.0% of the women exercised almost daily. The others did exercise 2-4 times per week. The level of exercise they performed was mostly light such as walking or jogging.

4. Blood Parameters

Blood parameters of the subjects by gender and presence of MC are presented in Table 4. All parameters assessed were not clearly different between the subjects with and without MC in both genders except plasma tHcy concentration of the women. The subjects with MC in the women had higher (p<0.05) plasma tHcy concentration than those without MC. Though it was not significant, the subjects with MC in the men tended to have higher plasma tHcy concentration than those without MC. Plasma tHcy concentration showed a gender difference; the male subjects had higher (p<0.05) tHcy concentration than the females. Blood glucose concentration was also higher (p<0.01) in the men than in the women. Except those two parameters, the plasma concentrations of HbA1c, TG, T-C, HDL-C, and FFA were not significantly different between the gender groups. Only three among these blood parameters, glucose, HbA1c,

Table 4. Blood parameters and blood pressures of the subjects according to gender and MC existence

Variables	Men			Women		
	W/ MC (n=19)	W/O MC (n=11)	Total (n=30)	W/ MC (n=33)	W/O MC (n=17)	Total (n=50)
Glucose (mg/dL)**	224.7± 91.3	270.2±145.5	254.0±112.4	203.1±105.7	201.5± 76.1	202.6± 95.8
HbA1c (%)	7.9± 2.0	8.3± 1.1	8.0± 1.7	7.5± 1.4	7.4± 1.2	7.5± 1.3
TG (mg/dL)	194.5±116.0	190.5±126.3	193.0±117.7	212.4±167.5	226.2±177.5	217.1±169.2
T-C (mg/dL)	210.3± 55.2	205.3± 29.0	208.5± 46.7	212.9± 57.9	210.4± 50.9	212.1± 55.1
HDL-C (mg/dL)	45.9± 11.6	53.9± 31.1	48.9± 20.8	44.1± 11.4	46.2± 12.5	44.8± 11.7
FFA (meq/L)	0.5± 0.2	0.6± 0.5	0.6± 0.3	0.6± 0.6	0.5± 0.3	0.6± 0.5
tHcy (μmol/L)*·**	10.9± 4.5	11.8± 5.8	11.2± 5.0	8.8± 2.6	10.9± 2.5	9.5± 2.7
Blood pressure (mmHg) : Systolic	138± 6	140± 11	139± 8	134± 9	140± 8	136± 8
Diastolic	83± 5	84± 6	83± 5	84± 5	85± 5	84± 5

Values are means±standard deviations.
The variables are significantly different between gender groups by the Chi-square test (*p<0.05, **p<0.01).
The variable is significantly different between with and without MC groups only in the men by the Chi-square test (**p<0.01).
MC; macro-vascular complications, HbA1c; glycosylated hemoglobin, TG; triglyceride, T-C; total cholesterol, HDL-C; high density lipoprotein-cholesterol, FFA; free fatty acid, tHcy; total homocysteine

and T-C, were higher than normal values. All other parameters were in their normal ranges. Plasma TG concentration was in the borderline high range, but only in the women.

5. Blood Parameters by Health-Related Lifestyle Habits

Among the health-related lifestyle habits determined in this study, only smoking showed significant relationships to some of the blood parameters. As presented in Fig. 1, the concentrations of blood glucose (p<0.05), plasma HbA1c (p<0.05), and plasma T-C (p<0.05) of smokers were significantly higher than those of non-smokers in the men. And, in the women, only glucose (p<0.01) and HbA1c (p<0.05) showed significant differences between smokers and non-smokers.

DISCUSSION

This study was performed to investigate the dietary and health-related lifestyle habits and blood parameters of NIDDM patients of both genders, compare the characteristics between the patients with and without MC, and analyze the relationships between lifestyle factors and blood parameters.

The results of this study showed that the women seemed to manage their diets better and engage in significantly less alcohol drinking and smoking than the men. The subjects with MC controlled their diets more regularly, tended to regulate the number of meals better, and smoke less than those without MC. These results imply that the male patients without MC might have some problems in maintaining their blood glucose. Actually, the men had higher blood glucose and plasma tHcy concentrations than the women and plasma tHcy concentration was higher in the female subjects without MC. However, plasma lipid profiles were not sig-

nificantly different between the genders and between the subjects with and without MC. Plasma concentrations of T-C of both genders were similar to the data from Chang et al.[12] and confirmed the result that there was no significant difference in plasma T-C concentrations between the subjects with and without MC. Although it was not significant, the men showed a tendency to like meat more than the women significantly. This is not surprising because it has already been reported that the men with NIDDM had high preference for animal food, but the women preferred vegetables.[14] In this study, though it was not significant, the subjects with MC compared to those without MC tended to like meat. Yet, the lipid profiles between the groups with and without MC were not different. This may be explained by the fact that subjects with MC managed their diets more regularly. Ninety percent of the men and 70% of the women prepared their meals by themselves. Considering their old ages, it may be assumed that there might be many problems in preparing proper meals for themselves. The result indicates that the subjects in this study did not have proper support from their family members and the men might have had more problems in preparing their meals than the women. The stronger the motivation behind dietary behavior modification, more comply with a family member's request, and the higher the degree of support from family members, the more successful the patient's diet therapy.[15] Most subjects had nutritional concerns about the consumption of sweeteners. Likewise, Park and Kim[13] reported that the concerns about diets of the diabetes patients, aged 20 to 70 years were avoiding sweeteners like sugar and honey, reducing the amount of meals, and substituting rice for barley.

Despite the fact that exercise improves the sensitivity to insulin and helps to decrease blood glucose in NIDDM patients,[8] half of the subjects had a weak perception of exercise and actually never or rarely exercised.

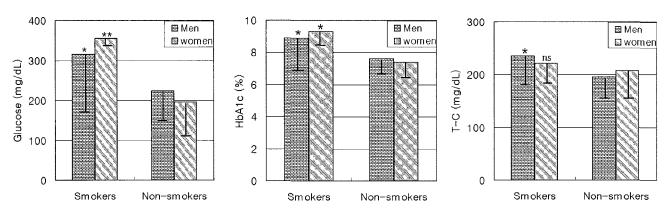It is very interesting to note that the subjects with MC

Fig. 1 Comparison of blood parameters between smokers and non-smokers in the subjects
Values are significantly different between smokers and non-smokers by t-test (*p<0.05, **p<0.01)
HbA1c; glycosylated hemoglobin, T-C; total cholestero

had lower plasma tHcy concentration than those without MC. It is well known that plasma tHcy is an independent predictor of CHD.[10] It could be explained that the subjects with MC controlled their diets more regularly and the percentage of the subjects who smoked was lower than the subjects without MC. Thus, the folate nutritional status of MC subjects, the most important modifiable determinant of plasma tHcy,[16] might be better than that of subjects without MC. The gender difference in plasma tHcy in this study is also understood by the reason that the women controlled the number and amount of their meals better and smoke less than the men. Thus, the women might have higher concentrations of plasma folate and vitamin B_{12} than the men. This gender difference is well known because estrogen may reduce plasma tHcy.[17] But, as considering that the subjects in this study were fairly old, estrogen is not a variable cause of this gender difference.

Smoking is one of the four major risk factors in coronary heart disease (CHD) and atherosclerosis,[4] because smoking irritates blood vessels and increases blood pressure.[18] In the Hordaland study, smoking is associated with elevated tHcy.[19] Surprisingly, smoking was not related to plasma tHcy concentration in this study. It could be understood that, although it was not determined, the amount of smoking by the subjects might not be excessive enough to increase plasma tHcy. One of the limitations here is that only 4% of the women in this study smoked. Therefore, we did not have statistical power enough. In fact, there was no significance in the data that suggests plasma T-C concentration of smokers were considerably higher than those of non-smokers in the women. These results show that smoking is not favorable when trying to control blood glucose and plasma cholesterol. However, smokers had higher blood glucose and plasma HbA1c and T-C concentrations among the men and also higher blood glucose and plasma HbA1c concentrations among the women. On the other hand, there were no significant relationships between the blood parameters and alcohol drinking and exercise. This may be due to the fact that even if the subjects had consumed alcoholic beverages, they were not heavy drinkers because they were diabetic and old. The effects of exercise on blood parameters might not have been apparent since most subjects rarely exercised regularly and participated in only light exercises. However, blood glucose, plasma HbA1c, T-C, TG, and tHcy concentrations of the subjects who exercised regularly tended to be lower.

In summary, this study shows that the subjects with MC compared to without MC and the female patients than the male controlled their diets more regularly, tended to regulate the number of meals better, and smoke less than those without MC. Although plasma lipid

profiles were not significantly different between the genders and between the subjects with and without MC, the men had higher blood glucose and plasma tHcy concentrations than the women and plasma tHcy concentration was higher in the female subjects without MC. These results imply that the male patients of NIDDM without MC might have more problems in maintaining their blood glucose. In addition, smoking may be the most important life-style factor influencing some blood parameters like blood glucose, HbA1c, and total cholesterol in the NIDDM patients.

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