Prevalence of dyslipidaemia in non-insulin-dependent diabetic patients attending armed forces clinics in Kuala Lumpur

Maznorila Mohamad[1] BSc, Dip in AdvNutr, Fatimah Arshad[1] Pgd Dip Diet, MSC, PhD, Md Idris Mohd Noor[2] MD, MPH and Rahman Ali[3] Md, MSc Med

1. Dept. of Nutrition and Dietetics, Faculty of Allied Health Sciences, National University of Malaysia, Kuala Lumpur
2. Dept. of Community Health, Faculty of Medicine, National University of Malaysia, Kuala Lumpur.
3. Health Corps, Malaysian Armed Forces.

The profile of serum lipids and lipoproteins, namely cholesterol, triglycerides, high density lipoprotein and low density lipoprotein, was studied in 70 patients with non-insulin dependent diabetes mellitus at armed forces clinics around Kuala Lumpur from June through to August 1994. Anthropometric measurements included weight and height which were measured using a SECA weighing balance with height scale attached, and percent body fat was determined from bioimpedance measurements. The haemoglobin A_{1c} and lipid profile levels were measured using commercially available methods from DAKO and Boehringer-Mannheim. Other variables were obtained using a prepared questionnaire. Using BMI≥30.0 kg/m^2 to denote obesity, the study showed that 32.9% of the sample were obese. The percentage of obese individuals increased to 70.8% when the fat percentage determined by bioelectrical impedance analyser was used. The criteria for obesity in male is ≥20% body fat and in female is ≥30%. A large number of cases (65.2%) had poorly controlled diabetes. The lipid profile of the patients showed that 80.0% were hypercholesterolaemic, 58.0% were hypertriglycedaemic and 68.5% had hyperLDL-cholesterolaemia. About 17.6% of them had low HDL-cholesterolaemia. There is no significant difference in serum lipid levels with sex and serum lipid levels among obese and non obese subjects.

Key words: Diabetes, NIDDM, dyslipidaemia, Malaysia, Kuala Lumpur, armed forces, obesity, gender

Introduction

Coronary heart disease (CHD) is the leading cause of death among patients with non-insulin-dependent diabetes mellitus (NIDDM). These patients have a high frequency of dyslipidaemia which, along with hyperglycaemia, obesity and hypertension may contribute significantly to accelerated coronary atherosclerosis. Since there are multiple risk factors for CHD, even mild degrees of dyslipidaemia may enhance CHD risk. Therefore, therapeutic strategies for management of NIDDM should give equal emphasis to the control of hyperglycaemia and dyslipidaemia[1].

The various cholesterol-carrying serum lipoproteins are independent predictors of CHD risk. Serum total cholesterol and low density lipoprotein cholesterol (LDL-cholesterol) levels are positively correlated with CHD, whereas high density lipoprotein cholesterol (HDL-cholesterol) concentrations are inversely related[2]. Although hyper-lipidaemia is thought to be common in adult diabetics, published reports give conflicting results[3-5]. Older reports are confounded by diabetic diets of an earlier era, when high fat and low carbohydrate intakes were generally recommended[6].

The objective of this study was to determine the magnitude of dyslipidaemia in NIDDM and factors which may contribute to this disorder in the patients attending armed forces clinics in Kuala Lumpur.

Subjects and methods

Subjects

This cross-sectional study was undertaken on patients who were diagnosed as having diabetes mellitus and had their diagnosis confirmed by a casual or a postprandial serum glucose level of at least 11.1mmol/L or a fasting serum glucose level of at least 7.8mmol/L on at least two occasions[7]. Only patients with NIDDM were considered for this study, that is those diabetic patients who were not taking insulin and who, if they were taking insulin, had an age of onset during adulthood and had also had therapy with oral antiglycaemic agents before.

Altogether, 70 diabetic patients who were under treatment for diabetes at all Armed Forces clinics around Kuala Lumpur participated in the study, which ran from early June through August 1994. Patients were asked to come to the clinic between 8 and 9am. after 12 hours of fasting. At the time of the visit, socioeconomic and demographic information and the patient's and family medical history were obtained using a structured questionnaire. One patient at a time was interviewed by a researcher. Other measurements and venesection were performed by trained medical personnel at the respective clinics.

Correspondence address: Ms Maznorila Mohamad, Jabatan Pemakanan dan Dietetik, Fakulti Sains Kesihatan Bersekutu, Universiti Kebangsan Malaysia, Jalan Raja Muda Abdul Aziz, 50300 Kuala Lumpur, Malaysia
Tel: +603 440 5511; Fax: +603 291 4304

Anthropometry

The height and body weight of each subject was measured using the SECA weighing balance with height attachment to the nearest decimal point with shoes and outer garments removed. The balance was calibrated weekly. Body weight status was estimated by the body mass index (BMI) computed in metric units as weight(kg)/height^2 (m^2) Obesity was defined as a body mass index ≥30 kg/m^2, as classified by Garrow[8].

Fat as a percentage of body weight was measured using a bioimpedance machine (Biodynamics Model 310 from USA), which was fully charged before operation. The subject was seated on a plastic or wooden chair and connected to the machine at the wrist and ankle on the left side of the body. All gold jewellery and metal items were removed from the subject preceding the test. Information on sex, age, weight and height were entered into the machine prior to the test. Fat percentage was obtained immediately.

Biochemical measurements

Ten ml venous blood was obtained while the subject was seated and tourniquet removed. A blood sample for determining glycated haemoglobin level (HbA_{1c}) was collected. It was collected in a heparinised (EDTA) tube to prevent clotting prior to laboratory analysis. The rest of the sample, for lipid profile, was kept in a universal bottle.

A sample of 0.05ml whole blood from the EDTA tube was transferred into another tube containing 1.0ml deionised water and was kept frozen at -20°C until further analysis. All samples were determined for quantitative glycated haemoglobin at the same time using an enzyme immunoassay (DAKO HbA_{1c}, UK). Standard procedures recommended by DAKO for analysing HbA_{1c} were followed. The measurement of glycated haemoglobin is a useful index for long term monitoring of glycaemic control in diabetic patients. Patients with good control or mild hyperglycaemia may have HbA_{1c} values within the non-diabetic reference interval, that is between 2.6 - 4.9 % HbA_{1c}[9].

The blood sample from the universal bottle was allowed to clot and then centrifuged for 5 minutes at 2000rpm. The clear supernatant (serum) was transferred into plastic tube and stored at -20°C until further analysis. Determination of serum cholesterol, triglycerides and HDL-cholesterol was performed using commercially available enzymatic colorimetric methods (Boehringer-Mannheim) and LDL-cholesterol was determined using Friedewald formula[10]: LDL-chol = cholesterol- triglycerides /2.2 - HDL-chol. Since this formula is only applicable to triglycerides levels < 4.6mmol/L, LDL-cholesterol levels could not be calculated for 15 subjects. Classification of hyper-lipidaemia and dyslipidaemia was based on recommendations by the National Cholesterol Education Program (NCEP)[11].

Statistical analysis

Statistical analysis of the data was carried out using Dbase III + and the Dbase Stats computer program. Results were expressed as mean ± standard deviation. Differences in means were tested using the t-test and the test considered significant when P was < 0.05.

Results and discussion

Description of the study sample

The total number screened was 70 non insulin dependent Diabetes Mellitus (NIDDM) patients with the mean duration of having diabetes of 6.0 ± 5.8 years. The majority of the sample was armed forces personnel: 53 (75.7%). Six (8.6%) were ex-personnel and 11 (15.7%) were civilian. All of them were staying with their families and eating at home most of the time. The mean age was 41.4 ± 9.8 years old and the mean working duration was 18.3 ± 6.3 years. The other characteristics of the samples are shown in Table 1.

Table 1. Sociodemographic description of the study sample.

		n	%
Sex	male	57	81.4
	female	13	18.6
Age group (years)	< 30	1	1.5
	30 - 39	36	51.4
	40 - 49	22	31.4
	>50	11	15.7
Ethnicity	Malay	57	81.4
	Indian	8	11.4
	Chinese	5	7.2

Some other physical characteristics of the patients are shown in Table 2. According to Garrow[8], the patients are classified as obese when BMI ≥ 30.0 kg/m^2. Based on that, 32.9% of the patients were obese. Durnin and Rahaman[12] categorised obesity as percent of body fat greater than 20% and 30% for male and female respectively. Using these criteria 70.8% of the sample were obese.

Prevalence of hyperlipidaemia

Hyperlipidaemia is defined as an elevation of plasma lipids such as cholesterol, cholesterol esters, phospholipids and triglycerides. Different studies[6,13-15] report different cut-off points for dyslipidaemia. However, the cut-off values used in this study were as follows: cholesterol ≥ 6.1mmol/L or triglycerides ≥ 2.7mmol/L, low density lipoprotein (LDL) ≥ 4.0mmol/L and high density lipoprotein (HDL) < 0.9mmol/L[11]. A subject was considered dyslipidaemic when one of the above criteria was fulfilled.

Table 2. The mean age, body mass index and % fat of the NIDDM.

	Age (years)	BMI (kg/m^2)	Fat (%)
Male (n=57)	39.3 ± 7.5	28.1 ± 4.1	22.4 ± 5.8
Female (n = 13)	50.2 ± 13.6	28.5 ± 4.3	35.7 ± 5.3

The prevalence of hyper-cholesterolaemia, hypertrigly-ceridaemia, hyper-LDL-cholesterolaemia and low HDL-cholesterolaemia among the NIDDM was 80.0%, 58.0%, 68.5% and 17.6% respectively. These are higher values than several other studies[13-16]. This could be because in other studies the sample size was much larger and probably covered both IDDM and NIDDM together[13,14]. Thus, the cut-off values for cholesterol were higher (≥ 6.7 mmol/L and ≥ 7.8 mmol/L)[13,14,16]. That cholesterol value is slightly elevated in diabetic subjects has been confirmed in various studies[3,17] and recent data from the NHANES study indicate

that 70% of diabetic patients have high or borderline-high cholesterol.[18]

Nevertheless, the prevalence of hypertriglyceridaemia in the present study falls within the range of 20% to 60% as reported in other studies[5]. Usually LDL-cholesterol levels are not elevated in NIDDM[19], but more than half of the study sample were found to have high LDL-cholesterol levels. The other characteristic lipid abnormality in NIDDM is reduced levels of HDL-cholesterol[20,21]. Even though found in this study, its prevalence is much lower when compared with other studies[14,15].

Another possible explanation for the higher prevalence of hyperlipidaemia could be that screening for the detection of hyperlipidaemia in these clinics has been recent. There was previously little awareness or treatment of hyperlipidaemia for these service personnel. Only 4.3% were receiving lipid lowering drug therapy.

Lipid Profiles

The reported characteristic pattern of dyslipidaemia in NIDDM consists of hypertriglyceridaemia, low HDL-cholesterol and normal LDL-cholesterol levels[6,17,19]. However, this pattern was not found in this study, as instead, and quite similar to another study[4] the HDL-cholesterol was high as shown in Table 3.

Table 3. Characteristics of HbA_{1c} and lipid abnormalities in NIDDM.

	HbA1c (%)	CHOL (mmol/L)	TG (mmol/L)	LDL (mmol/L)	HDL (mmol/L)
Mean	7.5	8.3	3.4	5.4	1.5
SD	4.2	2.4	1.6	2.4	0.9
Range	2.5 - 28.0	4.1 -17.0	1.0 - 8.1	1.9 -14.4	0.4 - 4.5
n	69	70	69	52	66

As shown in Table 4, the differences did not achieve statistical differences at the 0.05 level, but mean cholesterol and mean LDL-cholesterol levels were higher in women than in men. In contrast, men tend to have higher mean triglycerides concentrations than women. The same pattern has been noted in other studies[6,17].

Earlier studies[4,23] have shown that triglyceride and low HDL-cholesterol levels in NIDDM are independent of the degree of obesity. It has also been suggested that abnormal lipid patterns do not necessarily reflect higher levels of other nonlipid cardiovascular risk factors in NIDDM[4]. This study is in agreement. It revealed that cholesterol and LDL-cholesterol levels are not different by body mass index, as shown in Table 5. There is no significant difference of lipid levels with body mass index as shown in Table 5.

Table 4. The difference in mean lipid profiles between men and women.

Mean lipid profiles	Women (mmol/L)	Men (mmol/L)
Cholesterol	8.8±2.5 (n = 13)	8.2±2.4 (n = 57)
Triglycerides	2.8±1.2 (n=13)	3.5±1.7 (n= 56)
LDL-Cholesterol	6.0±2.1 (n = 10)	5.3±2.5 (n = 42)
HDL-Cholesterol	1.4±0.7 (n = 12)	1. 5±1.0 (n = 54)

The severity of obesity is a determinant of lipoprotein abnormality in NIDDM, besides the degree of glycaemic control[19]. Using a t-test, there were no significant differences in percentage of body fat with severity of lipid status.

Table 5. The difference in mean lipid profiles according to BMI.

Mean lipid profiles (mmol/L)	Non obese (BMI <30.0)	Obese (BMI ≥ 30.0)
Cholesterol	8.6±2.5 (n = 47)	7.8±2.1 (n = 23)
Triglycerides	3.6±1.8 (n = 46)	3.0±1.1 (n = 23)
LDL-Cholesterol	5.7±2.5 (n = 32)	5.0±2.2 (n = 20)
HDL-Cholesterol	1.5±0.9 (n = 44)	1.6±1.0 (n = 22)

BMI is body mass index (kg/m^2)

Glycaemic Control

HbA_{1c} is a good indicator of glycaemic control as it does not change rapidly in response to fluctuations in blood glucose, but rather reflects a time-averaged history of glucose concentration in the preceding 2-3 months. In poorly controlled diabetic patients, blood glucose concentration is persistently elevated and the levels of glycated proteins are higher (HbA_{1c} >4.9%) than in well controlled or non-diabetic individuals (HbA_{1c} <4.9%). In the present study the percentage with poorly controlled diabetes is higher (65.2%) than for well-controlled diabetic patients (34.8 %).

Table 3 indicates that a large proportion of the sample had poorly controlled diabetes, since the mean value of HbA_{1c} was high (7.5±4.2%). This may relate to a high prevalence of dyslipidaemia among these patients. The most frequent lipid abnormalities in poorly controlled or untreated NIDDM are hypertriglyceridaemia, low levels of HDL-cholesterol and increased VLDL levels[5]. The elevated LDL-cholesterol in this study is likely to be due to increased VLDL secretion[22].

In Table 6, poor glycaemic control is reflected in lipid profile, notably HDL-cholesterol. Other studies[5,22] find that poor glycaemic control can be responsible for low HDL-cholesterol. In general, elevated serum cholesterol, triglycerides, LDL-cholesterol and reduced HDL-cholesterol are more marked in poorly glycaemic controlled patients.

Table 6. The mean of % fat and % HbA_{1c} in patients having normal lipid levels and dyslipidaemia

	mmol/L	Fat (%)	HbA_{1c} (%)
Cholesterol	< 6.1	22.7±7.5	5.6±1.7
	> 6.2	25.6±7.8	8.0±4.5
Triglycerides	< 2.7	26.7±8.6	6.7±3.9
	> 2.8	24.0±7.0	8.0±4.4
LDL-cholesterol	< 4.0	22.5±8.1	5.9±1.8
	> 4.1	26.2±8.2	7.4±3.8
HDL-cholesterol	< 0 9	24.1±5.8	10.0±8.2*
	> 1.0	24.9±8.1	7.2±2.9*

*P < 0.05

Conclusion

The percentage of poorly controlled diabetes in this study is high (65.2%), as measured by glycated haemoglobin. This could, in turn, contribute to the higher prevalence of dyslipidaemia compared with previous studies. In the 70 patients who participated in this study, 80.0% had

hypercholesterolaemia, 58.0% hypertriglyceridaemia, and 68.5% and 17.6% had hyperLDL-cholesterol and low HDL-cholesterol respectively. There was a significant difference between HbA_{1c} and hyperlipidaemia, (with low HDL-cholesterol concentrations).

The obese group and the non-obese groups did not differ significantly in lipid levels. Serum lipids did not differ significantly by gender.

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M Maznorila, A Fatimah, MN Idris and A Rahman

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吉隆坡武裝部隊診療所非胰島素依賴性糖尿病人血脂異常的患病率

摘要

1994 年 6 月至 8 月作者在吉隆坡武裝部隊診療所研究了 70 位非胰島素依賴性糖尿病人的血清脂類和脂蛋白情況。這裡包括了膽固醇、甘油三酯、高密度脂蛋白和低密度脂蛋白的情況。人體測量的項目包括身高和體重，用附有標尺的 SECA 體重計測量。用生物電阻抗測定體脂百分數，用 DAKO 和 Boehninger-Mannheim 的商業方法測定血紅蛋白 A1C 和血脂水平，用問卷得到其它變數。 BMI > 30.0 公斤/米^2 定爲肥胖症，研究表明肥胖者佔 32.9%。當用生物電阻抗分析儀測定體脂百分數時，肥胖者增至 70.8%。肥胖症的標準是男性體脂 > 20%，女性體脂 > 30%。大量病人 (65.2%) 糖尿病沒有很好控制。病人血脂顯示高 膽固醇血症佔 80.0%，高甘油三酯血症 58.0% 和高 LDL-膽固醇血症佔 68.5%。低 HDL-膽固醇血症約佔 17.6%。不同性別血脂沒有明顯差異，同時，肥胖與非肥胖病人的血脂也沒有明顯差異。

References

1. Garg A, Grundy SM. Management of dyslipidaemia in NIDDM Diabetes Care 1990;13:153-69.
2. Linn S, Fulwood R, Carroll M *et al.* Senum total cholesterol: HDL-cholesterol ratios in US white and black adults by selected demographic and socioeconomic variables (HANES II). Am J Public Health 1991;81;1038-43.
3. Frier BM, Sudek CD. Cholesterol metabolism in diabetes: the effect of insulin on the kinetics of plasma sequalene. J Clin Endocrinol Metab 1979;49:824-8.
4. Ronnemaa T, Laakso M, Kallio V *et al.* Serum lipids, lipoproteins and apolipoproteins and the excessive occurrence of coronary heart disease in non-insulin-dependent diabetic patients. Am J Epidemiol 1989;130(4):632-45.
5. Taskinen M. Quantitative and qualitative lipoprotein abnormalities in diabetes mellitus. Diabetes 1992; 41 (Suppl 2):12-17.
6. Barrett-Connor E, Grundy SM, Holdbrook MJ. Plasma lipids and diabetes mellitus in an adult community. Am J Epidemiol 1982; 115(5): 657-63.
7. Klein R, Klein BEK, Moss SE *et al.* Glycosylated hemoglobin predicts the incidence and progression of diabetic retinopathy. JAMA 1988; 260: 2864-71.
8. Garrow JS. Treat obesity seriously: A clinical manual. London: Churchill Livingstone, 1981.
9. DAKO Diagnostics Ltd, Ely, Cambs, UK. DAKO HbA 1c Diagnostics Manual, code No K6300. 1993.
10. Friedewald WT, Levy RJ, Fredrickson DS. Estimation of the concentration of low density lipoprotein cholesterol in plasma, without use of the preparation ultracentrifuge. Clin Chem 1972; 18: 499-509.
11. National Cholesterol Education Program Expert Panel, National Heart, Lung, and Blood Institute. Report of the National Cholesterol Education Program Expert Panel, on detection, evaluation, and treatment of high blood holesterol in adults. Arch Intern Med 1988; 148: 36-69.
12. Dumin JVGA, Rahaman MM. The assessment of the amount of fat in the body from the measurements of skinfold thickness. Br J Nutr 1967; 21: 681 -89.
13. Diabetes Drafting Group: Prevalence of small vessel and large vessel disease in diabetic patients from 14 centres. The World Health Organization multinational Study of Vascular Disease in Diabetics. Diabetologia 1985; 28 (Suppl.1): 615-40.
14. Wilson PWF, Kannel WB, Anderson KM. Lipids, glucose intolerance and vascular disease: the Framingham Study. MonogrAtheroscler 1985; 13: 1-11.
15. Haffner SM, Stern MP, Hazuda HP *et al.* Cardiovascular risk factors in confimmed prediabetics: does the clock for coronary heart disease start ticking before the onset of clinical diabetes?. JAMA 1990; 263: 2893-98.
16. Henefeld M, Schulze J, Fisher S *et al.* The diabetes intervention study (DIS): a cooperative multi-intervention trial with newly manifested type 11 diabetics: preliminary results. Monogr Atheroscler 1985; 13: 98-103.
17. Assmann G, Schulte H. The Prospective Cardiovascular Munster (PROCAM) study: Prevalence of hyperlipidemia in persons with hypertension and/or diabetes mellitus and the relationship to coronary heart disease. Am Heart J 1988; 116: 1713-24.
18. Harris M. Hypercholesterolemia in diabetes and glucose intolerance in the US population. Diabetes Care 1991; 14: 366-74.
19. Garg A. Lipid-lowering therapy and macrovascular disease in diabetes mellitus. Diabetes 1992;41 (Suppl.2):111-15.
20. - Stern MP, Patterson JK, Haffner SM *et al.* Lack of awareness and treatment of hyperlipidemia in type 11 diabetes in a community survey. JAMA 1989; 262: 360-64.
21. Howard BV. Lipoprotein metabolism in diabetes mellitus. J Lipid Res 1987; 28: 613-28.
22. Hagan J, Wylie-Rosett J. Perspectives in Practice. Lipids: Impact on dietary prescription in diabetes. J Am DietAssoc 1989; 89: 1104-08.
23. Laakso M, Voutilainen E, Sarlund H *et al.* Serum lipids and lipoproteins in middle-aged noninsulin-dependent diabetics. Atherosclerosis 1985; 56: 271-81.