**Factors associated with poor glycemic control among type 2 diabetes NunAh hospital, Bangkok Thailand.**

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**Abstract**

**Background :** Poor glycemic control among type 2 diabetic patients contribute to major complications of diabetic patients. Diabetes is a chronic disease that need prolonged care and lifestyle changes.

**Objectives :** to determine the factorsassociated with poor glycemic control in type 2 diabetic patients attending diabetic clinic NunAh hospital Bangkok Thailand.

**Setting :** NunAh hospital Bangkok, Thailand.

**Research design :** case control study. Poor glycemic control defined as HbA1c(A1c) >7.0% for ≥1 year.

**Participants :** type 2 diabetic patients. N= 315

**Methods** : The sample are selected from type2 diabetic patients of NunAh hospital. Simple random selection to select every alternate patient from the patient who visit diabetic clinic on each working day. This descriptive study was conducted between January 1 and June 30, 2016. Poor glycemic control was defined as hemoglobin A1c(HbA1c) ≥7mg/dl for 1 year and good glycemic control was defined as hemoglobin A1c(HbA1c)< 7mg/dl. The variables from last record in medical record used to evaluate were gender, age, educational level, fasting blood sugar (FBS), body mass index(BMI), hemoglobin A1c (HbA1c), total cholesterol, triglyceride, HDL-cholesterol, LDL-cholesterol, creatinine and appointment score. Direct interview used for data of duration of diabetes, smoke cigarette, drinking alcohol, drinking coffee, physical exercise and feeling of foot numbness(peripheral neuropathy). We conducted chi-square to examine factors related to sustained poor control during the year. OpenEpi (open software) was used for this descriptive study.

**Results :** Among 315 patients were included in the study. Female was 61%, mean age 64.44 years, educational level of primary school 77%, unemployed 73.7%, mean BMI 26.28, mean duration of diabetes 8.04 years, on oral antidiabetic agent 91.1%, co-morbidity with hypertension 90.2%. The proportion of poor glycemic control was 61.2 % (193) patients. Factors found associated to poor glycemic control were using oral antidiabetic agent combined with insulin (p<0.001, OR=0.12 95%CI =0.028- 0.516) , FBS>130mf/dl (p<0.03, OR=1.752, 95%CI =1.054-2.912) , creatinine>1.5mg/dl (p<0.001, OR=14.601, 95%CI =1.945-109.623), peripheral neuropathy (p<0.008, OR=2.073, 95%CI =1.098-3.911) and appointment score (p<0.029, OR=1.752, 95%CI =1.055-2.826) .

**Conclusion :** Results indicated that factors found significantly related to poor glycemic control were using combination antidiabetic agent of oral antigen and insulin, FBS>130 mg/dl, , creatinine level >1,5 mg/dl, peripheral neuropathy and appointment score <4. Patients with these characteristics may need additional therapies and targeted interventions to improve glycemic control.

**Keywords :**  Poor glycemic control; Type 2 diabetes;

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**บทคัดย่อ**

**เหตุผลของการวิจัย** : การควบคุมระดับน้ำตาลในเลือดที่ได้ผลไม่ดี ในผู้ป่วยเบาหวานชนิดที่ 2 เป็นสาเหตุสำคัญของภาวะแทรกซ้อนของผู้ป่วยเบาหวาน โรคเบาหวานเป็นโรคเรื้อรัง ที่ต้องการการดูแลเป็นเวลานานและการเปลี่ยนแปลงวิถีชีวิต

**วัตถุประสงค์** : เพื่อหาปัจจัยที่สัมพันธ์กับการควบคุมระดับน้ำตาลในเลือดที่ได้ผลไม่ดี ในผู้ป่วยเบาหวานชนิดที่ 2 จากผู้ป่วยคลินิกเบาหวาน โรงพยาบาลนันอา กรุงเทพฯ ประเทศไทย

**รูปแบบการวิจัย :**  การศึกษาแบบมีกลุ่มควบคุมการควบคุมระดับน้ำตาลเลือดได้ไม่ดี คือ ผู้ป่วยเบาหวานที่มีระดับ HbA1c(A1c) มากกว่าร้อยละ 7.0 เป็นเวลาตั้งแต่ 1 ปีขึ้นไป

**สถานที่ทำการศึกษา** : โรงพยาบาลนันอา กรุงเทพฯ ประเทศไทย

**กลุ่มตัวอย่าง :**  ผู้ป่วยเบาหวานชนิดที่ 2 โรงพยาบาลนันอา

**วิธีการศึกษา :**  เลือกซุ่มตัวอย่าง อย่างง่าย เลือกผู้ป่วยคนเว้นคน จากผู้ป่วยที่มารับการรักษาที่คลินิกเบาหวาน ในทุกวันทำการ ระหว่าง 1 มกราคม ถึง 30 มิถุนายน 2559

**ผลการศึกษา :** ผู้ป่วยโรคเบาหวานชนิดที่ 2 รวม 315 ราย เพศหญิงร้อยละ 61 อายุเฉลี่ย 64.44 ปีระดับการศึกษา ประถมศึกษา ร้อยละ 77 ไม่ได้ประกอบอาชีพ ร้อยละ 73.7 ค่าดัชนีมวลกายเฉลี่ย ร้อยละ 26.28 ระยะเวลาป่วยโรคเบาหวานเฉลี่ย 8.04 ปี รักษาด้วยยารับประทาน ร้อยละ 91.1 มีโรคความดันโลหิตสูงร่วม ร้อยละ 90.2 สัดส่วนของผู้ที่ควบคุมระดับน้ำตาลในเลือด ได้ไม่ดี ร้อยละ 61.2 (193 ราย) ปัจจัยที่เกี่ยวข้องกับการควบคุมระดับน้ำตาลในเลือดได้ไม่ดี คือ การใช้ยาฉีดอินซูลินร่วมกับยารับประทาน (p <0.001, OR = 0.12 95% CI = 0.028 - 0.516), FBS > 130 mg/dl (p <0.03, OR = 1.752, 95% CI = 1.054-2.912), creatinine> 1.5 mg/dl (p <0.001, OR = 14.601, 95% CI = 1.945-109.623), โรคระบบประสาทส่วนปลาย (p <0.008, OR = 2.073, 95% CI = 1.098-3.911) และ คะแนนการมาตรวจไม่ตรงตามนัด (p <0.029 หรือ = 1.752, 95% CI = 1.055-2.826)

**สรุป :** ปัจจัยที่มีความสัมพันธ์กับการควบคุมระดับน้ำตาลในเลือดได้ไม่ดี คือ การใช้ยาฉีดอินซูลินร่วมกับการกินยาเบาหวาน, และ ระดับ FBS มากกว่า 130 mg / dl ระดับ creatinine มากกว่า 1,5 mg/dl ความผิดปกติของระบบประสาทส่วนปลาย และคะแนนการมาตรวจไม่ตรงตามนัด น้อยกว่า 4 ผู้ป่วยที่มีลักษณะเหล่านี้อาจต้องได้รับการบำบัดเพิ่มเติมและการแทรกแซงเป้าหมายเพื่อปรับปรุงการควบคุมระดับน้ำตาลในเลือด

**คำสำคัญ :**  การควบคุมระดับน้ำตาลเลือดได้ไม่ดี, ผู้ป่วยเบาหวานชนิดที่ 2

**Background**

 By the year 2030, diabetes mellitus may increase to 439 million with prevalence of 7.7 %. (1) The clinical characteristics of diabetes are symptomatic glucose intolerance

resulting in hyperglycemia and alterations in lipid and protein metabolism (2).

Poor and inadequate glycemic control among patients with T2DM constitutes a major public health problem and major risk factor for the development of diabetes complications (3).

Both patient and health care provider-related factors may contribute to poor glycemic control (4). The Diabetes Complication Control Trial (DCCT) has proved the importance of tight glycemic control for the prevention of control complication among insulin-dependent DM patients (5). The American Diabetes Association (ADA) has designated HbA1c level of <7% as a goal of optimal blood glucose control (6).

**Methods**

The population in this study was type 2 diabetes attending diabetic clinic NunAh hospital for at least 1 year. Simple random sampling to select every alternate patient who visit diabetic clinic on each service day. This descriptive study are conducted between January 1 and June 30, 2016 from adult type 2 diabetic patients.

Data from patient’s record last reading were age, gender, body mass index (BMI), blood pressure, HbA1c, fasting blood sugar, cholesterol, triglyceride, high-density lipoprotein (HDL), low-density lipoprotein (LDL) and creatinine.

Personal interview to collect data including level of education, occupation(employed, unemployed), duration of diabetes and peripheral neuropathy (feeling numbness in their feet). Data of self care behavior were coffee drinking, cigarette, alcohol drinking, physical exercise and their visit correct of the date of appoinment.

Poor glycemic control is HbA1c ≥7% and good glycemic control is HbA1c <7%. (American Diabetes Association, 2007).

Definition for appointment score were the score to give to the patient according to their right time of appointment by counting back 5 visits from the last visit. The patient who come right to all 5 visits get 5 scores, who come right to 4 of the 5 visits get 4, right for 3 of 5 visits get 3 and so on. The patient who never come right to their visit get 1.

The inclusion criteria for participants are 1) diabetic patients on treatment ; 2) be at least aged 18; 3) be enrolled with medical and drug coverage at least 1 year; 4) have HbA1c measured at least once each year.

BMI was categorized as overweight if BMI was ≥25 kg/m2.

Criteria for abnormal lipid profile based on the ADA criteria (American Diabetes Association, 2004). Hypercholesterolemia refers to a total cholesterol level ≥200 mg/dl. Hypertriglyceridemia refers to a level ≥150 mg/dl. HDL level was considered low when in males <40 mg/dl and in females <50 mg/dl. LDL was considered high when the level is ≥100 mg/dl. Dyslipidemia was defined as the presence of one or more of the previous abnormalities in serum lipids. People who were on antidyslipemia medication were defined as having dyslipidemia. People who were on antihypertensive medication were defined as having hypertension.

Data entry and analysis was carried out using SPSS (version 16.0 for windows; SPSS). Data is reported using mean (±S.D.) for continuous variables and proportions for categorical variables. Chi-square test was used to assess statistical significance of the difference in the percentages of good and poor glycemic control according to independent categorical variables. Binary logistic regression analysis was conducted to identify factors, if not managed appropriately, could lead to poor glycemic control and subsequent complications. Statistical significance was set at p<0.05.

**Results**

**Participants' characteristic**

This study included a total of 315 patients of type 2 DM (192 females and 123 males) with aged between 30-93 years, with a mean age 64.44 ±10.78 years. Most of the participants had educational level of primary school (77%) . More than half of the patients (73.7 %) were unemployed. The average body mass index was 26.28 ± 5.43. About 6% were current smoker. About 91% of patients were on oral antidiabetic agents and the rest 9.0% were on combination of oral antidiabetic agents and insulin. Mean duration of diabetes was 8.04 ± 5.29 years. Their clinical, anthropometric, and relevant characteristics are shown in Table 1.

All the sample were divided into 2 groups based on HbA1c, poor glycemic control (A1c>7 mg/dl) and good control (A1c <7mg/dl). After data analized by chi-square test with statistical significant (p<0.05). The variables found significant were type of medication, appointment score , FBS, creatinine and peripheral neuropathy.

Poor glycemic control patients were 193(61.2%). Diabetes was more likely to be poorly controlled among those with fasting blood sugar >130 mg/dl, increased on combination of oral antidiabetic agent and insulin , appointment score <5, had peripheral neuropathy and creatinine lever >1.5 mg/dl.

Table 1 Demographic, anthropometric and clinical of patients.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Variables** | **A1C ≥7** | **A1C <7** | **N (%)** | **x̅ ± SD** | **Chi** | **sig** | **odd** | **95%CI** | **upp** |
| **Gender** |  |  | **315 (100)** |  | **0.132** | **0.716** | **0.916** | **0.571** | **1.469** |
| **Female** | **121 (36.5)** | **71 (24.4)** | **192 (61.0)** |  |  |  |  |  |  |
| **Male** | **80 (24.7)** | **43 (14.2)** | **123 (39.0)** |  |  |  |  |  |  |
| **Age** |  |  |  | **64.44 ± 10.78** | **0.023** | **0.879** | **0.965** | **0.609** | **1.529** |
| **>65** | **104 (23.8)** | **60 (12.6)** | **164 (52.1)** |  |  |  |  |  |  |
| **<64** | **97(20.3)** | **54(12.3)** | **151 (47.9)** |  |  |  |  |  |  |
| **Education** |  |  |  |  |  |  |  |  |  |
| **illiterate** | **25 (7.9)** | **13 (4.1)** | **38 (12.1)** |  |  |  |  |  |  |
| **Primary school** | **154 (46.0)** | **89 (31.1)** | **243 (77.1)** |  |  |  |  |  |  |
| **≥High school** | **22 (7.3)** | **12(3.4)** | **34 (10.8)** |  |  |  |  |  |  |
| **BMI** |  |  |  | **26.28 ± 5.34** | **0.433** | **0.510** | **1.168** | **0.735** | **1.956** |
| **≥25** | **117 (12.6)** | **62 (20.1)** | **179 (56.8)** |  |  |  |  |  |  |
| **<25** | **84 (26.4)** | **52 (4.7)** | **136** |  |  |  |  |  |  |
| **Duration DM year** |  |  |  | **8.04 ± 5.29** | **0.178** | **0.673** | **1.105** | **0.695** | **1.756** |
| **≥7**  | **116(36.1)** | **63 (20.6)** |  |  |  |  |  |  |  |
| **<7** | **85 (25.0)** | **51 (18.0)** | **136 (43.2)** |  |  |  |  |  |  |
| **Peri neuro.** |  |  |  | **0.00** | 7.099 | 0.008 | 0.472 | 0.270 | 0.826 |
| **Yes** | **65** | **21** | **116 (36.8)** |  |  |  |  |  |  |
| **no** | **136** | **93** | **199 (63.1)** |  |  |  |  |  |  |
| **Exercise** |  |  |  | **0.00** | **2.716** | **0.099** | **1.583** | **0.915** | **2.74** |
| **Not done** | **164 (49.8)** | **84 (28.8)** | **248 (7.6)** |  |  |  |  |  |  |
| **Do exercise** | **37 (11.4)** | **30 (9.8)** | **67 (92.4)** |  |  |  |  |  |  |
| **Coffee** |  |  |  | **0.00** | 0.550 | 0.458 | 0.735 | 0.325 | 1.663 |
| **Drink** | **21** | **9** | **17 (5.4)** |  |  |  |  |  |  |
| **Not drink** | **180** | **105** | **298 (94.6)** |  |  |  |  |  |  |
| **Alcohol** |  |  |  |  | **3.98** | **0.046** | **0.375** | **0.139** | **1.015** |
| **Drink** | **7** | **10** | **17 (6.3)** |  |  |  |  |  |  |
| **Not drink** | **194** | **104** | **298 (93.7)** |  |  |  |  |  |  |
| **Cigarette** |  |  |  |  | **0.718** | **0.397** | **1.48** | **0.594** | **3.68** |
| **Smoke** | **11** | **9** | **20 (78.7)** |  |  |  |  |  |  |
| **Not smoke** | **190** | **105** | **295 (21.3)** |  |  |  |  |  |  |
| **App score** |  |  |  | **4.25 ± 1.19** | 4.766 | 0.029 | 1.727 | 1.055 | 2.826 |
| **< 5**  | **83 (25.3)** | **33 (11.4)** | **285(90.5)** |  |  |  |  |  |  |
| **= 5**  | **118 (35.8)** | **81 (27.3)** | **30(9.5)** |  |  |  |  |  |  |
| **Medication** |  |  |  |  | **11.22** | **0.001** | **0.120** | **0.028** | **0.516** |
| **Oral+insulin** | **26 (8.2)** | **2 (0.6)** | **28 (8.9)** |  |  |  |  |  |  |
| **Oral drug** | **175 (53.0)** | **112 (38.0)** | **287 (91.1)** |  |  |  |  |  |  |
| **Hypertension** |  |  |  |  | **0.491** | **0.483** | **0.764** | **0.36** | **1.624** |
| **Has HTN** | **183(55.5)** | **101 (34.6)** | **284 (90.2)** |  |  |  |  |  |  |
| **No HTN**  | **18 (5.7)** | **13 (4.1)** | **31 (9.8)** |  |  |  |  |  |  |
| **FBS** |  |  |  | **162.31± 48.88** | **4.735** | **0.03** | **1.752** | **1.054** | **2.912** |
| **>130** | **155** | **75** | **230** |  |  |  |  |  |  |
| **≤130** | **46** | **39** | **85** |  |  |  |  |  |  |
| **Creatinine** |  |  |  | **1.07± 0.45** | 11.537 | 0.001 | 14.601 | 1.945 | 109.623 |
| **>1.5** | **23** | **1** | **24** |  |  |  |  |  |  |
| **≤1.5** | **178** | **113** | **291** |  |  |  |  |  |  |
| **cholest** |  |  |  | **192.49 ± 41.82** | **0.001** | **0.97** | **1.009** | **0.636** | **1.60** |
| **≥200** | **93 (28.2)** | **53(18.0)** | **146 (46.3)** |  |  |  |  |  |  |
| **<200** | **108 (33.0)** | **61 (20.6)** | **169 (53.7)** |  |  |  |  |  |  |
| **Triglyceride** |  |  |  | **158.98 ± 78.92** | **0.000** | **0.982** | **1.005** | **0.635** | **1.592** |
| **≥150** | **102 (31.1)** | **58 (19.6)** | **105 (33.3)** |  |  |  |  |  |  |
| **<150** | **99 (30.1)** | **56 (19.0)** | **210 (66.7)** |  |  |  |  |  |  |
| **LDL** |  |  |  | **113.57 ± 34.22** | **2.22** | **0.136** | **0.693** | **0.428** | **1.123** |
| **≥100** | **61 (42.8)** | **44 (23.8)** | **105 (31.7)** |  |  |  |  |  |  |
| **<100** | **140 (18.4)** | **70 (14.9)** | **210 (7.3)** |  |  |  |  |  |  |
| **HDL** |  |  | **115 (36.5)** | **51.7 ± 14.77** |  |  |  |  |  |
| **Male ≥40**  | **64 (20.0)** | **36 (11.7)** | **77 (24.4)** |  |  |  |  |  |  |
| **Male <40** | **16 (4.7)** | **7 (2.5)** |  |  |  |  |  |  |  |
| **Female ≥50** | **67 (19.3)** | **48 (17.1)** | **230 (73.0)** |  |  |  |  |  |  |
| **Female <50** | **54 (17.1)** | **23 (7.3)** | **85 (27.0)** |  |  |  |  |  |  |
| **Variables** | **A1C ≥7** | **A1C <7** | **N (%)** | **x̅ ± SD** | **Chi** | **p** | **odd** | **CI** |  |

Table 2 showed this statistical analysis with Binary logistic regression.

Table 2 clinical characteristics of participants

|  |  |  |  |
| --- | --- | --- | --- |
|   | p | OR | 95% C.I.for OR |
| Lower | Upper |
| Gender | 0.042 | 4.702 | 1.060 | 20.853 |
| age\_65 | 0.944 | 0.980 | 0.553 | 1.735 |
| educat\_level | 0.322 | 1.352 | 0.744 | 2.459 |
| BMI\_25 | 0.386 | 1.285 | 0.729 | 2.265 |
| Dur\_DM\_7 | 0.446 | 1.239 | 0.714 | 2.152 |
| App score\_4 | 0.013 | 2.053 | 1.163 | 3.623 |
| Peripher neu. | 0.003 | 2.660 | 1.410 | 5.019 |
| coffee | 0.118 | 2.165 | 0.822 | 5.702 |
| cigarette | 0.485 | 0.672 | 0.220 | 2.052 |
| alcohol | 0.162 | 2.331 | 0.713 | 7.624 |
| exercise | 0.097 | 0.577 | 0.302 | 1.104 |
| HTN\_comorbid | 0.432 | 1.430 | 0.587 | 3.482 |
| Med\_oral\_insulin | 0.005 | 0.112 | 0.024 | 0.508 |
| FBS\_130 | 0.002 | 2.610 | 1.426 | 4.777 |
| TC\_200 | 0.538 | 1.241 | 0.625 | 2.463 |
| TG\_150 | 0.762 | 0.920 | 0.535 | 1.581 |
| LDL\_100 | 0.046 | 0.504 | 0.256 | 0.989 |
| HDL\_M40\_F50 | 0.063 | 0.561 | 0.305 | 1.032 |
| CR\_1.5 | 0.007 | 17.515 | 2.206 | 139.076 |
|  |  |  |  |  |

**Discussion**

This study found the proportion of poor glycemic control (HbA1c >7%) 61.2% (193) patients. This was nearly the same as studied in Amman Jordan reported of 65.1%. (Maysaa Khattab) (7). Whereas the studied in Trinidad, reported a much higher of 85% had HbA1c >7% (Ezenwaka & Offiah, 2001) (8). Therefore, glycemic control is essential in diabetes management.

Of the total 315 patients, 73% had a FBG level of > 130 mg/dl and mean FBS 162 mg/dl which resulting in poor glycemic control of this group of patients. This mean FBS was nearly the same as the study from Ambo Ethiopia mean glycemic level 168 mg/dl.(9)

In our study, female gender is significantly associated with poor glycemic control (p= 0.042). While study of Angamo MT in southwest Ethiopia did not find the association with gender. **(10)**

Hyperlipidemia is common in patients with type 2 diabetes. Characteristically, they have elevated triglyceride levels, while HDL levels are low, and LDL levels are typically normal or elevated**.(11).** This study also found the association of LDL>100 mg/dl and poor glycemic control.(OR=0.504, 95%CI=0.256-0.989)

 The appointment score which measure how the patients pay attention to their appointment time showed the association with poor glycemic control. The lesser score 36.7% (OR = **1.691**, 95%CI **1.043-2.742**) may reflected their less attention to their diabetes too.

In this study, patients with poor glycemic control were more likely to be prescribed combination of oral antidiabetic agents and insulin (OR=0.127, 95%CI 0.025-0.642). The association between treatment with combination of oral antidiabeticc agents plus insulin and poor glycemic control is consistent with the study of AL-Nuaim in Saudi. (12).

Therefore, patients who were treated by combination therapy of oral antidiabetic agents and insulin. Could be patients with poor glycemic control.

In our study, we found the association between poor glycemic control and creatinine level >1.5 mg/dl (OR **14.60, 95%CI 1.94-109.62** ). Sanal TS also found the association between poor glycemic control and hypertension, neuropathy, retinopathy, renal failure and neurological disorders.(13) Though the studies of Saydah S H. found no association between HTN, renal disease, and glycemic control. (14)

Our study also revealed that patients who had peripheral neuropathy had a 2.2 times more risk to develop poor glycemic control than patients with no comorbidities (OR = 2.2, 95%CI 1.16-4.23). Similarly, study in Ethiopia by Woldu MA also revealed that patients who had peripheral neuropathy had a 579 times more risk to develop poor glycemic control than patients with no comorbidities.(15)

**Conclusions**

The proportion of patients with poor glycemic control was high, which was nearly comparable to that reported from many countries. FBS, creatinine level , appointment acore , duration of diabetes, peripheral neuropathy and combination treatment of oral antidibetic agent and insulin were associated with poor glycemic control. Educational program that emphasizes lifestyle modification with adherence to treatment regimen, appropriate management of comorbidities and special care for geriatric patients would be of great benefit in glycemic control.

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