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ORIGINAL RESEARCH

Attainment of recommended therapeutic targets of modifiable cardiovascular risk factors among individuals with type 2 diabetes mellitus screened at a diabetes clinic in Sri Lanka

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Introduction: Implementation of effective measures to control rising burden of cardiovascular diseases among patients with type 2 diabetes mellitus (T2DM) requires information on the adequacy of control and identification of specific groups with suboptimal control of blood glucose, lipids and blood pressure.

Methods: A cross-sectional study of patients with T2DM referred from primary care to a diabetes center was carried out to estimate the proportion of patients achieving the recommended therapeutic targets of four major modifiable cardiovascular risk factors: glycosylated hemoglobin (HbA1c <7%), low-density lipoprotein cholesterol <100 mg/dL, systolic blood pressure (SBP) <130 mmHg and diastolic blood pressure (DBP) <80 mmHg and their associations with age, gender, duration of diabetes and body mass index were studied.

Results: Mean (SD) age and the duration of the sample of 2422 (65% males) were 52 (11) and 9 (3), respectively. Percentages with optimal HbA1c, low-density lipoprotein cholesterol, SBP and DBP were 25.2%, 24.3%, 32% and 56.7%, respectively. Only 2% had achieved optimal control of all four risk factors. Significantly higher percentages of males were having optimal HbA1C, SBP and DBP, and regression analysis revealed that male gender was significantly associated with optimal control of SBP.

Conclusion: Control of cardiovascular risk diseases factors among patients with T2DM managed in the primary care settings needs further improvements in target achievement in all four modifiable risk factors.

Keywords: suboptimal control, therapeutic targets, type 2 diabetes mellitus, Sri Lanka

Plain language summary

What is known about this subject

Attainment of optimal levels of blood glucose, low-density lipoprotein and blood pressure is associated with significant reductions in morbidity and mortality among individuals with type 2 diabetes mellitus.

What this paper reveals

- Optimal blood glucose and low-density lipoprotein levels were attained by one in four patients and optimal blood pressure levels were attained by one in three patients and control of all four risk factors were seen only in two out of 100 patients with diabetes at primary care setting in Sri Lanka.
- Compared to males, significantly higher percentage of female patients with diabetes had suboptimal control of glucose, systolic and diastolic blood pressures.

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- With increasing age, patients with diabetes have better control of glucose and low-density lipoprotein levels.

Introduction

Rising incidence of type 2 diabetes mellitus (T2DM) is associated with a substantial increase in the burden of cardiovascular diseases (CVD) among individuals in South Asian countries.[1] Interventional studies have revealed that morbidity and mortality from CVD among individuals with and without diabetes could be significantly reduced by the interventions aimed at controlling modifiable risk factors for CVD such as elevated blood glucose, low-density lipoproteins (LDLs), systolic blood pressure (SBP) and diastolic blood pressure (DBP).[2,3] Based on the findings of these studies, professional organizations such as the American Diabetes Association (ADA) recommend control of four major modifiable CVD risk factors below an optimal level for both primary and secondary prevention of CVD in patients with diabetes.[4]

There is a rising incidence of T2DM among both rural and urban populations in Sri Lanka.[5,6] Hospital admissions caused by CVD including coronary artery disease (CAD) and cerebrovascular diseases have also shown a marked increase in Sri Lanka.[7] Although there is evidence of increasing incidence of T2DM and its heavy burden on the health care system, research focused on the adequacy of control of modifiable CVD risk factors and the proportion of patients with T2DM achieving recommended therapeutic goals of major CVD risk factors in Sri Lanka are limited. Effective implementation of population-based measures to control CVD in patients with T2DM requires not only the knowledge on the proportions of patients with suboptimal CVD risk factor control but also the recognition of special groups of patients with T2DM with suboptimal control of these risk factors. These data can help authorities to plan more focused and effective measures to reduce the rising burden of CVD in this community.

We aimed to study the proportion of patients who achieve recommended therapeutic targets of four major cardiovascular risk factors, namely, blood glucose, LDL cholesterol, SBP and DBP among patients with T2DM referred from different primary care settings for screening at a diabetes center in Southern Sri Lanka. We also studied the association of gender, age, duration of diabetes and body mass index (BMI) in relation to optimal control in each of the four cardiovascular risk factors.

Methods

This descriptive study included patients with T2DM screened at a diabetes center over a period of 4 years from January 2012. All included patients were primarily managed at the community settings (general practitioners, rural and district hospitals). We requested primary care practitioners to refer their patients with long-standing diabetes for a free single visit screening. All eligible patients were over the age of 18 years and had diabetes for at least 1 year. All pregnant females and lactating mothers and patients with type 1 diabetes and those with clinical diagnosis of T2DM for less than 1 year were excluded. Those with a history of hospital admission due to an infection before 3 months of referral (febrile illnesses with symptoms of urinary, chest or skin and soft tissue infection or presumed or confirmed viral infection) were also excluded. Patients with major comorbidities such as chronic liver disease, currently on treatment for malignancies, long-term steroid treatment were also excluded. Patients with major comorbidities such as chronic liver disease, currently on treatment for malignancies, long-term steroid treatment were also excluded. Data on age (obtained from the national identity card) to the nearest year, duration of diabetes to the nearest year (verified from the clinic records) were obtained. Information of patient's drug treatment at the time of the referral as on oral hypoglycemic agents with or without insulin, antihypertensive agents and lipid lowering drugs were also obtained. Patients' weight and height were measured and their BMI was calculated. Blood pressure (BP) was recorded after at least 5-min rest using an electronic instrument (Omron Corporation, Tokyo, Japan), as the mean of two readings taken 5 min apart and drew venous blood into a fluoride tube to measure plasma glucose concentration. The initial data collections each took around 10–15 min. Roughly 15 patients were screened each week and the study was completed over a period of 4 years.

All chemical analyses including glycosylated hemoglobin (HbA1c) and LDL cholesterol were performed in the laboratory attached to the Diabetes Center and same method of biochemical analysis was used throughout the study period. Overnight fasting venous blood samples were collected to measure lipid profile. HbA1c level was used as a measure of glucose control which was estimated using high-performance liquid chromatography (HPLC) method.

Ethical approval

Ethical clearance for the present study was obtained from the Institutional Ethics Committee of the Faculty of Medicine, University of Ruhuna. Written informed consent was obtained from all study subjects in the local language.

Definition of optimal control

Recommended therapeutic targets laid down by the ADA for management of patients with diabetes were used as the

optimal cutoff levels. Optimal glucose control was defined as HbA1c of <7% and LDL cholesterol was defined as <100 mg/dL. Optimal SBP and DBP were defined as 130 and 80 mmHg, respectively.[8]

Statistical analysis

Data were entered and analyzed using the Statistical Package for Social Sciences version 16.0. The findings were expressed in terms of proportions. Chi-square test was used to study the difference between the optimal versus non optimal glycemic control groups. *P*-value <0.05 was considered as statistically significant. Factors likely to be associated with glycemic control were further assessed by an independent sample *t*-test and logistic regression analysis.

Results

The mean (SD) age of the total study sample (n=2422) was 52 (11) years and 65% of them (n=1563) were males. Descriptive data of the participants in the study are shown in Table 1.

Table 2 shows the metabolic control of the study group with regard to the individual risk factors considered. Of the total study sample, only 48 (2%) had optimal control with regard to all four parameters: glucose, LDL, SBP and DBP.

Table 3 shows a comparison of characteristics in relation to glucose control in patients with diabetes. Patients with optimal control of glucose were significantly different with those with suboptimal glucose control with regard to age, duration of disease, gender and BMI (*P* <0.05). Regression analysis revealed that only age (OR = 1.02; 95% CI: 1.01–1.03) and duration of T2DM (OR =0.97; 95% CI: 0.95–0.98) were significantly associated with optimal blood glucose control.

Table 4 shows a comparison of characteristics in relation to optimal SBP control in patients with diabetes. Except BMI, all other factors considered were significantly different among patients with optimal control of SBP with those without good control (*P* < 0.05). Regression analysis revealed that male gender (OR =1.28; 95% CI: 1.06–1.53), age (OR = 0.94; 95% CI: 0.93–0.95) and duration of T2DM (OR = 0.97; 95% CI: 0.95–0.99) were significantly associated with optimal control in SBP.

Table 5 shows a comparison of characteristics in relation to DBP control in patients with diabetes. All the factors considered were significantly different among patients with optimal control of DBP with those without good control (*P* <0.05). Regression analysis revealed that age (OR = 0.97; 95% CI: 0.96–0.98) and BMI (OR =0.95; 95% CI: 0.92–0.99) were significantly associated with optimal control in DBP.

Table 6 shows a comparison of characteristics in relation to LDL control in patients with diabetes. Patients with optimal control of LDL were significantly different with those without good LDL control with regard to age, duration of disease, BMI and waist circumference (*P* <0.05). Regression analysis revealed that only age (OR =1.01; 95% CI: 1.00–1.02) and

Table 1 Descriptive data of the patients with diabetes (n=2422)

Factors	Male (n=1563)	Female (n=859)	*P*-value
Age (years)	51 (11)	53 (10)	0.09
Duration of diabetes (years)	9 (3)	9 (3)	0.09
SBP (mmHg)	124 (16)	127 (18)	0.08
DBP (mmHg)	78 (9)	79 (8)	0.12
HbA1c (%)	7.5 (0.7)	7.4 (0.7)	0.14
LDL	124 (35)	126 (35)	0.09

Abbreviations: SBP, systolic blood pressure; DBP, diastolic blood pressure; HbA1c, glycosylated hemoglobin; LDL, low-density lipoprotein.

Table 2 Metabolic control with regard to control on HbA1c and low-density lipoprotein

Factors	Percentage
Glucose control (HbA1c< 7%)	25.2
LDL control (<100 mg/dL)	24.3
SBP control (<130 mmHg)	56.7
DBP control (<80 mmHg)	32

Abbreviations: HbA1c, glycosylated hemoglobin; LDL, low-density lipoprotein; SBP, systolic blood pressure; DBP, diastolic blood pressure.

Table 3 Comparison of characteristics between patients with and without optimal glucose control

Variable	Patients with optimal glucose control	Patients with suboptimal glucose control	*P*-value
Age (years)	53 (11)	52 (10)	0.001
Duration (years)	8.2 (3)	8.8 (3)	0.02
Gender (male)	60.2%	65.8%	0.01
BMI (kg/m^2)	24.8 (4.4)	24.3 (3.8)	0.02

Note: Data are mean (SD) or n (%).
Abbreviation: BMI, body mass index.

Table 4 Comparison of characteristics between patients with and without SBP control

Variable	Patients with optimal SBP control	Patients with suboptimal SBP control	*P*-value
Age (years)	48.9 (10.1)	56.1 (9.8)	0.000
Duration (years)	7.6 (5.2)	10.0 (6.4)	0.000
Gender (male)	68.5%	59.3%	0.000
BMI (kg/m^2)	24.3 (4.1)	24.6 (3.8)	0.13

Note: Data are mean (SD) or n (%).
Abbreviations: SBP, systolic blood pressure; BMI, body mass index.

Table 5 Comparison of characteristics between patients with and without DBP control

Variable	Patients with optimal DBP control	Patients with suboptimal DBP control	*P*-value
Age (years)	49.6 (10.9)	53.1 (10.2)	0.000
Duration (years)	8.1 (5.4)	8.9 (6.0)	0.001
Gender (male)	68.6%	62.5%	0.004
BMI (kg/m^2)	23.9 (3.5)	24.7 (4.1)	0.000

Note: Data are mean (SD) or n (%).
Abbreviations: DBP, diastolic blood pressure; BMI, body mass index.

Table 6 Comparison of characteristics between patients with and without LDL control

Variable	Patients with optimal LDL control	Patients with suboptimal LDL control	*P*-value
Age (years)	53.6 (10.5)	51.6 (10.6)	0.000
Duration (years)	9.6 (5.9)	8.4 (5.8)	0.000
Gender (male)	66.9%	63.5%	0.14
BMI (kg/m^2)	24.8 (3.7)	24.3 (4.0)	0.02

Note: Data are mean (SD) or n (%).
Abbreviations: LDL, low-density lipoprotein; BMI, body mass index.

duration of DM (OR =1.03; 95% CI: 1.01–1.04) were significantly associated with optimal LDL control.

Discussion

Results of this study revealed several important findings on the control of four modifiable cardiovascular risk factors among patients with T2DM, managed at the primary care setting in a developing country. One of the main highlights is the very high percentage of patients with suboptimal control of individual CVD risk factors with only 23%, 24% and 32% achieving the recommended therapeutic targets in glucose, LDL cholesterol and DBP, respectively. Control of SBP was marginally above 50%. Only 2% of the participants in this study had achieved optimal control of all four risk factors.

Because of significantly higher incidence of coronary artery and cerebrovascular diseases, T2DM is considered by some as a cardiovascular risk equivalent.[9] In the management point of view, therapeutic measures to reduce morbidity and mortality from CVD in patients with T2DM are directed toward stringent control of four major modifiable risk factors for CVD: blood glucose, LDL cholesterol, SBP and DBP. Interventional studies have revealed that control of all four factors together could result in significantly higher additive benefits and improve clinical outcomes from CVD than the control of individual risk factor alone.[10] Therefore, professional organizations have advocated multipronged approach by recommending optimal therapeutic targets for major CVD risk factors in order to combat rising incidence CVD morbidity and mortality among patients with diabetes.[11] However, many studies conducted in different settings mentioned subsequently reveal disappointing results with regard to the proportion of patients achieving recommended therapeutic goals in the aforementioned risk factors.

Published literature on the control of CVD risk factors among individuals with T2DM in Sri Lanka is very limited. The only available study has reported that <50% of 230 patients attending a diabetes clinic achieved optimal glucose control (fasting plasma glucose level of less than 126 mg/dL).[12] Research conducted in most other developing countries on this subject also report similar findings. A cross-sectional study from Iran involving 2640 patients with T2DM attending a tertiary care diabetes center has reported that HbA1c <7%, BP of 140/90 mmHg and LDL cholesterol less than 100 mg/dL was achieved by 37.4%, 35.3% and 48.9% of the subjects studied, respectively. Only 7.7% has achieved all three targets.[13] A multicenter study from South Korea, involving 2610 patients with T2DM, has reported that the recommended target achievement of HbA1c, BP and LDL cholesterol were 24.8%, 49.4% and 63.6%.[14] In this study too, the percentage achieving the recommended optimal target control of all four risk factors was higher (7.8%) than the finding (2%) in our study. But, they have used HbA1c level of 6.5% as the optimal glucose control target. A multicenter, cross-sectional survey involving nine developing countries in Latin America (Argentina, Brazil, Chile, Costa Rica, Ecuador, Guatemala, Mexico, Peru and Venezuela) has reported that HbA1C of <7% was seen among 43% of participants (n=3592).[15] All these studies report a comparatively higher target achievement by patients with T2DM, especially with regard to optimal blood glucose control than the findings in our study.

Studies from developed countries such as USA on control of CVD risk factors reveal that a much higher percentages of patients with T2DM achieve recommended therapeutic targets in glucose, BP and LDL cholesterol compared to the respective figures from the developing countries. National health and Nutrition Examination Survey which examined 10,367 patients with T2DM revealed that 58.2% had achieved HbA1c <7% and LDL <100 mg/dL and BP of 130/80 mmHg was seen among 43.8% and 44.2%, respectively.[16]

Improved socioeconomic level with better health literacy rates of patients and better delivery of health promotion and health care delivery in the developed compared to the developing countries may explain the observed differences in achieving the recommended therapeutic targets in CVD risk

factors in these studies. However, a later study that examined the trends in the control of CVD risk factors among 2403 patients with T2DM in the USA over a decade from 1999 to 2010 had revealed that only one-fourth of patients with T2DM achieve optimal levels of all four risk factors in America and there was an improvement in achievement of recommended therapeutic goals which was more marked among those without CVD than those with CVD.[17]

Gender differences in the control of CVD risk factors with more females failing to achieve recommended therapeutic levels than males are often highlighted in cardiovascular epidemiology. Almost all the studies describing suboptimal CVD risk factor control in women compared to men in literature come from developed countries in Europe and America.

A study of 201 (46% women) patients with T2DM attending Diabetes Clinic in Europe has revealed that women had higher mean (SE) SBP (155.4 [22.5] vs 141.0 [19.8] mmHg for men; $P<0.001$) and total cholesterol (TC) (5.28 [1.34] vs 4.86 [1.29] mmol/L for men; $P<0.05$), but a lower TC:HDL-C ratio (4.1 [1.19] vs 4.5 [1.2] for men; $P<0.05$).[18] Slightly more men (32.4%) than women (26.9%) reached the therapeutic goal of <7.0% for glycosylated hemoglobin. Women with diabetes duration <10 years received oral antidiabetic therapy less frequently ($P<0.05$). Women diabetes duration longer than 10 years had hypertension more frequently than their male counterparts (100% vs 86.0%, respectively; $P<0.01$). Men had greater overall adherence to diabetes and cardiovascular risk guidelines than did women (66.4% vs 58.9%, respectively; $P<0.01$). Another cross-sectional study of 680 people recruited from three primary care settings in USA which studied the composite control CVD risk factors (HbA1c <7%, BP of <130/80 mmHg and LDL cholesterol level of <100 mg/dL) has reported women had poorer composite control compared with men (5.9% vs 17.3%).[19] Adjusted logistic models showed that men were significantly more likely to have composite risk factor control (odds ratio 2.90; 95% CI: 1.37–6.13) compared with women. A meta-analysis on gender-specific mortality in diabetes has reported that CVD and CHD mortality in men was lower for diabetes alone (CVD mortality HR: 0.82, 95% CI: 0.69–0.98; CHD mortality HR: 0.73, 95% CI: 0.65–0.83). In contrast, rates appeared to be higher in women with diabetes alone (CVD mortality HR: 1.29, 95% CI: 0.79–2.26; CHD mortality HR: 1.28, 95% CI: 0.75–2.22). All-cause mortality in men was similar for diabetes and previous CVD (HR: 1.02, 95% CI: 0.93–1.12), whereas among women, it was at least as high and possibly higher for diabetes alone (HR: 1.25, 95% CI: 0.89–1.76).[20]

Findings of our study, although based on data in a single center, is the first to describe similar trend in higher percentage of females with poorer CVD risk factor control than males with T2DM from a developing country in the South Asian region. Underlying reasons for this finding among females could be multifactorial. They include patient factors such as reduced health literacy rates, non-adherence to prescribed medications and lifestyle changes in females and physician factors such as inertia of prescribing and uptitrating the medication doses to achieve recommended therapeutic goals.[21,22] Findings of the studies cited here along with ours reveal that the phenomenon of gender-based discrepancy of unfavorable CVD risk factor control affects the females with diabetes in the developed and developing countries alike.

Although there were significantly higher percentages of females with suboptimal HbA1C, SBP and DBP regression analysis revealed that female gender is significantly associated with suboptimal control of SBP only. Association of the other three CVD risk factors with female gender remained non-significant. Regression analysis also found that with increasing age of patients with T2DM, there was better control of HbA1c and LDL cholesterol. In other words, younger patients with T2DM are more likely to have suboptimal HbA1c and LDL cholesterol levels. Studies done elsewhere also have revealed that younger age is associated with suboptimal control of glucose and CVD risk factors.[23,24] This could probably be due to lack of symptoms in the early years of diabetes and lack of proper guidelines to treat elevated cholesterol in younger patients and or poor adherence to prescribed dietary advices and medications among younger individuals with diabetes compared to the elderly patients with symptoms and complications.

BP control both systolic and diastolic was better among younger patients with T2DM on the regression analysis. This is quite expected finding as the prevalence of BP is anyway associated with increasing age even in the normal population.

Regression analysis revealed that the advancing age of the patient and longer duration of diabetes was associated with optimal LDL cholesterol levels in this study. More frequent prescription of LDL cholesterol reducing drugs such as statins with comorbidities associated with increasing age such as coronary and cerebrovascular diseases may account for this finding.

In summary, our study found that the control of four major modifiable CVD risk factors, either as single or as a composite of all four factors among patients with T2DM is worse than the reported figures from studies conducted in the other developing countries. The observed figures in our

study were very much unsatisfactory when compared with those from the developed countries. We also found the worse control of three of the four factors in a significantly higher percentage of females.

The main strength of this study is the recruitment of all the participants managed in the different settings at primary care including general practitioners, district hospitals, etc. This enabled us to study a real-life situation of CVD risk factor control of more than 2000 patients with T2DM managed at the primary care. Being a single-center study is a notable limitation of this study and hence generalizing these results to represent the whole country should be done with caution. We hope our findings would be an impetus to the public health authorities in our country to design multicenter study to get a better picture of CVD risk factor control among patients managed in the primary care setting in the future.

Conclusion

We report that the CVD risk factor control among patients with T2DM managed at the primary care level is very unsatisfactory with regard to achieving the recommended therapeutic targets in glucose, LDL cholesterol and SBP and DBP. Finding of mere 2% of the sample achieving the optimal control of all four risk factors poses a major challenge and concern on the preventive care strategies practiced at the primary care level in a developing country, which is currently burdened with the dual epidemics of T2DM and CVD.

Disclosure

The authors report no conflicts of interest in this work.

References

1. Gholap N, Davies M, Patel K, Sattar N, Khunti K. Type 2 diabetes and cardiovascular disease in South Asians. *Prim Care Diabetes*. 2011;5(1):45–56.
2. Stark Casagrande S, Fradkin JE, Saydah SH, Rust KF, Cowie CC. The prevalence of meeting A1C, blood pressure, and LDL goals among people with diabetes, 1988-2010. *Diabetes Care*. 2013;36(8):2271–2279.
3. Dailey G. Early and intensive therapy for management of hyperglycemia and cardiovascular risk factors in patients with type 2 diabetes. *Clin Ther*. 2011;33(6):665–678.
4. American Diabetes Association. Executive summary: standards of medical care in diabetes – 2014. *Diabetes Care*. 2014;37(suppl 1):S5–S13.
5. Katulanda P, Sheriff MH, Matthews DR. The diabetes epidemic in Sri Lanka – a growing problem. *Ceylon Med J*. 2006;51(1):26–28.
6. Jayawardena R, Ranasinghe P, Byrne NM, Soares MJ, Katulanda P, Hills AP. Prevalence and trends of the diabetes epidemic in South Asia: a systematic review and meta-analysis. *BMC Public Health*. 2012;12:380.
7. Premaratne R, Amarasinghe A, Wickremasinghe AR. Hospitalisation trends due to selected non-communicable diseases in Sri Lanka, 2005-2010. *Ceylon Med J*. 2005;50(2):51–54.
8. Armstrong C. ADA updates standards of medical care for patients with diabetes mellitus. *Am Fam Physician*. 2017;95(1):40–43.
9. Candido R, Srivastava P, Cooper ME, Burrell LM. Diabetes mellitus: a cardiovascular disease. *Curr Opin Investig Drugs*. 2003;4(9):1088–1094.
10. Gaede PH, Jepsen PV, Larsen JN, Jensen GV, Parving HH, Pedersen OB. [The Steno-2 study. Intensive multifactorial intervention reduces the occurrence of cardiovascular disease in patients with type 2 diabetes]. *Ugeskr Laeg*. 2003;165(26):2658–2661.
11. Garza L, Dols J, Gillespie M. An initiative to improve primary prevention of cardiovascular disease in adults with type II diabetes based on the ACC/AHA (2013) and ADA (2016) guidelines. *J Am Assoc Nurse Pract*. 2017;29(10):606–611.
12. Amarasekara AA, Fongkaew W, Wimalasekera SW, Turale S, Chanprasit C. Cross-sectional study of glycemic control among adults with type 2 diabetes. *Nurs Health Sci*. 2015;17(2):223–228.
13. Janghorbani M, Papi B, Amini M. Current status of glucose, blood pressure and lipid management in type 2 diabetes clinic attendees in Isfahan, Iran. *J Diabetes Investig*. 2015;6(6):716–725.
14. Jung JH, Lee JH, Noh JW, et al. Current status of management in type 2 diabetes mellitus at general hospitals in South Korea. *Diabetes Metab J*. 2015;39(4):307–315.
15. Lopez Stewart G, Tambascia M, Rosas Guzman J, Etchegoyen F, Ortega Carrion J, Artemenko S. Control of type 2 diabetes mellitus among general practitioners in private practice in nine countries of Latin America. *Rev Panam Salud Publica*. 2007;22(1):12–20.
16. Wong K, Glovaci D, Malik S, et al. Comparison of demographic factors and cardiovascular risk factor control among U.S. adults with type 2 diabetes by insulin treatment classification. *J Diabetes Complications*. 2012;26(3):169–174.
17. Wong ND, Patao C, Wong K, Malik S, Franklin SS, Iloeje U. Trends in control of cardiovascular risk factors among US adults with type 2 diabetes from 1999 to 2010: comparison by prevalent cardiovascular disease status. *Diab Vasc Dis Res*. 2013;10(6):505–513.
18. Kautzky-Willer A, Kamyar MR, Gerhat D, et al. Sex-specific differences in metabolic control, cardiovascular risk, and interventions in patients with type 2 diabetes mellitus. *Gend Med*. 2010;7(6):571–583.
19. Strom Williams JL, Lynch CP, Winchester R, Thomas L, Keith B, Egede LE. Gender differences in composite control of cardiovascular risk factors among patients with type 2 diabetes. *Diabetes Technol Ther*. 2014;16(7):421–427.
20. Lee C, Joseph L, Colosimo A, Dasgupta K. Mortality in diabetes compared with previous cardiovascular disease: a gender-specific meta-analysis. *Diabetes Metab*. 2012;38(5):420–427.
21. Kramer HU, Raum E, Ruter G, et al. Gender disparities in diabetes and coronary heart disease medication among patients with type 2 diabetes: results from the DIANA study. *Cardiovasc Diabetol*. 2012;11:88.
22. Penno G, Solini A, Bonora E, et al; Renal Insufficiency And Cardiovascular Events (RIACE) Study, Group. Gender differences in cardiovascular disease risk factors, treatments and complications in patients with type 2 diabetes: the RIACE Italian multicentre study. *J Intern Med*. 2013;274(2):176–191.
23. Barrot-de la Puente J, Mata-Cases M, Franch-Nadal J, et al. Older type 2 diabetic patients are more likely to achieve glycaemic and cardiovascular risk factors targets than younger patients: analysis of a primary care database. *Int J Clin Pract*. 2015;69(12):1486–1495.
24. Subramanian U, Schmittdiel JA, Gavin N, et al. The association of patient age with cardiovascular disease risk factor treatment and control in diabetes. *J Gen Intern Med*. 2009;24(9):1049–1052.