INTRODUCTION

The prevalence of diabetes has increased significantly in recent decades. The International Diabetes Federation stated that 382 million people worldwide suffered from diabetes in 2013, and this number is expected to rise to 592 million by 2035 [1]. Diabetes resulted in 1.3 million mortalities in 2010, which was twice as high as that in 1990 [2]. Furthermore, diabetes-related complications, such as retinopathy, neuropathy, nephropathy, and cardiovascular and cerebrovascular diseases, are increasing the burden on individuals and healthcare systems [3,4]. The American Diabetes Association (ADA) and European Association for the Study of Diabetes recommend that the management of patients with type 2 diabetes should include glucose control to achieve a hemoglobin A1c (A1C) level of ≤ 7%, as well as lifestyle changes, including smoking cessation and control of blood pressure (BP) and lipid levels [5].

PREVALENCE OF DIABETES

The prevalence of diabetes increased from 8.6% to 11.0% from 2001 to 2013. According to the diabetes fact sheet 2015, the proportion of patients with diabetes treated with antihypertensive medications increased from 56.0% to 62.5% from 2006 to 2013, and 49.5% of those with diabetes were being treated with lipid-lowering medications in 2013, a 1.8-fold increase since 2006. According to the 2014 Korea National Health and Nutrition Examination Survey data, 45.6% of patients with diabetes achieved a hemoglobin A1c level of < 7.0%, 72.8% achieved a blood pressure of < 140/85 mmHg, and 58.0% achieved a low density lipoprotein cholesterol level of < 100 mg/dL. Only 19.7% of patients with diabetes had good control of all three of these parameters. Despite improvements in health promotion efforts, the rates of adherence to medication and risk-factor control are low. Therefore, a systematic approach to managing diabetes, including self-management education, is needed to prevent or delay complications. The government needs to establish a long-term policy to address the growing burden of diabetes.

Keywords: Diabetes mellitus; Diabetes management; Korea
er, the number of new patients with diabetes decreased from 2005 to 2009 [8].

The prevalence of diabetes has increased particularly in individuals aged ≥ 70 years; the rate of diabetes in this age group was 27.6% in 2013, which was approximately twice as high as that in 2001. In addition, the prevalence of diabetes has also increased slightly in younger and middle-aged subjects [6]. The median age of new patients with diabetes decreased by approximately 6 years from 2004 to 2012 [8]. Several studies have shown that the onset of type 2 diabetes at a younger age may lead to poorer glycemic control, greater risk of complications, and higher mortality compared with an older age of onset [9-11].

According to the diabetes fact sheet of the Korean Diabetes Association (KDA), the prevalence of prediabetes, defined as a fasting glucose level of 100 to 125 mg/dL, also increased from 21.5% to 25.0% from 2006 to 2013 [12]. Annually, 5% to 10% of those with prediabetes progress to diabetes, and prediabetes also causes concomitant damage to end organs such as the eyes, kidneys, blood vessels, and the heart [13,14]. Considering this situation, effective and diverse strategies to prevent diabetes and prediabetes are needed.

**OBESITY AND DIABETES**

Obesity is the most common comorbidity in individuals with type 2 diabetes. In addition, obesity triggers the development of diabetic complications [15]. The ADA recommended obesity control to prevent progression from prediabetes to diabetes and to improve glycemic control in type 2 diabetes [16]. Obesity control also may be necessary for improving high blood pressure and lipid profiles [17].

In Korea, the prevalence of obesity has increased from 29.2% in 2001 to 31.8% in 2013 [6]. In particular, the number of obese patients with diabetes has increased. According to a primary care clinic-based survey, 77% of patients with newly diagnosed diabetes have a body mass index (BMI) > 23.0 kg/m² [18]. In 2013, the prevalence of obesity/overweight with diabetes was 71.6% in men and 74.2% in women [6]. The mean BMI of patients with diabetes increased from 21.9 to 24.8 kg/m² over nearly two decades [19,20]. Furthermore, an inverse linear relationship was detected between BMI and age at diabetes diagnosis among newly diagnosed patients. The mean BMI decreased from 30.4 kg/m² in the youngest age group to 24.4 kg/m² in the oldest age group [6,21].

**MANAGING DIABETES**

The Diabetes Control and Complications Trial (DCCT) and the United Kingdom Prospective Diabetes Study showed that improving glycemic control, lowering BP and lipid levels, and avoiding smoking help reduce microvascular and macrovascular diseases [22-27]. Therefore, guidelines for diabetes care recommend management of lifestyle (diet, weight control, smoking cessation, and physical activity) and risk factors (A1C < 7.0%, BP < 140/90 mmHg, and low density lipoprotein cholesterol [LDL-C] < 100 mg/dL) and regular screening to treat conditions related to diabetes during the early stages [17]. The 2015 KDA’s guideline recommended a BP target of < 140/85 mmHg in patients with diabetes [28].

Because reduced adherence to regimens results in poor health outcomes, comprehensive management of type 2 diabetes should consider adherence to relevant medications [29,30].

According to the KDA, the medication adherence rate, which is estimated using the medication possession ratio, increased from 12.8% to 44.9% from 2002 to 2013 [31]. The proportion of patients with diabetes treated with antihypertensive medications increased from 56.0% to 62.5% during 2006 to 2013. Approximately 50% of patients with diabetes were being treated with lipid-lowering medications in 2013, a 1.8-fold increase since 2006 [12]. According to the 2014 Korea National Health and Nutrition Examination Survey (KNHANES) study, 45.6% of patients with diabetes achieved A1C < 7.0%, 72.8% achieved BP < 140/85 mmHg, and 58.0% achieved LDL-C < 100 mg/dL. Only 19.7% of patients with diabetes had good control of all three parameters (Fig. 1, unpublished data). Control rates in 2014 improved compared with those from the 2005 health insurance data, in which 40.3% of patients achieved A1C < 7.0%, 58.6% achieved BP < 140/90 mmHg, and 38.3% achieved LDL-C < 100 mg/dL [7,19]. In particular, the glycemic control rate (defined as A1C ≥ 8.0%) decreased steadily from 33.6% in
2005 to 25.9% in 2012 to 22.5% in 2014 (Fig. 2, unpublished data) [19]. Almost half of the male patients with diabetes are still smoking (Fig. 1, unpublished data).

The A1C level is considered a clinical marker of diabetes as well as a precise indicator of long-term glycemic control. However, most individuals do not fully comprehend its meaning. Thus, many studies have translated A1C values into blood glucose levels to increase understanding of the clinical implications of A1C. In Korea, Kim et al. [32] also suggested an association between the mean blood glucose level measured by the oral glucose tolerance test and A1C, expressed as a linear regression: mean glucose (mg/dL) = 49.4 × A1C (%) – 149.6 ($R^2 = 0.54$, $p < 0.001$). The linear regression equation was fairly dissimilar from that in the A1C Derived Average Glucose study and DCCT cohort [32].

### DIABETES-RELATED COMPLICATIONS

Diabetes is associated with chronic complications, such as microvascular and macrovascular diseases, and other diseases including dementia and depression [33]. The DCCT/EDIC demonstrated that achieving glycemic control reduces the rate of microvascular complications [34]. Previous studies have shown that the duration of diabetes is associated with an increased risk of micro- and macrovascular complications [35].

The prevalence rates of neuropathy, retinopathy, and nephropathy in Korea are 33.5%, 20.0%, and 5.5%, respectively, in patients with diabetes [36,37]. According to the diabetes fact sheet, 1.2% of patients with type 2 diabetes have end-stage renal disease (ESRD), and 15.9% have diabetic retinopathy [12]. In particular, the incidence of diabetic nephropathy is increasing rapidly, and it is the most common cause of ESRD [38].

The prevalence rates of cardiovascular, cerebrovascular, and peripheral vascular diseases in patients with type 2 diabetes were 5.5%, 5.0%, and 1.1%, respectively, during 2006 to 2009 according to the Korean National Diabetes Program [39]. The 2009 to 2011 Health Insurance Review and Assessment database indicated that the
prevalence rates of coronary artery, cerebrovascular, and peripheral artery diseases were 14.1%, 8.8%, and 0.3%, respectively, in patients newly diagnosed with type 2 diabetes [40]. The presence of macrovascular complications was higher in patients with type 2 diabetes than in those without (295 cases of ischemic stroke, 248 cases of ischemic heart disease, and 41 cases of cerebral hemorrhage/10,000 persons with diabetes; 62 cases of ischemic stroke, 59 cases of ischemic heart disease, and 17 cases of cerebral hemorrhage/10,000 non-diabetic persons) [12].

The prevalence of diabetic complications is expected to increase with the prevalence of diabetes. Regular screening is necessary to prevent complications. However, only 36.3% and 40.5% of patients received screening for diabetic retinopathy and nephropathy, respectively, in Korea [41].

Diabetes and cancers are closely linked epidemiologically and biologically. Convincing evidence indicates that diabetes is associated with an increased risk of several types of cancers [42]. The presence of cancer-related hospitalization in Korea was higher in patients with type 2 diabetes than in those without. Specifically, in subjects with type 2 diabetes, the risks of hospitalization events due to stomach, colorectal, liver, pancreatic, and lung cancers were 37.9, 43.4, 17.6, and 36/10,000 persons, respectively [12].

Moreover, previous studies reported association between diabetes and risk of psychiatric disorders. The KNHANES reported that diabetes is associated with a marked increase in suicidal ideation and suicide attempts [43,44]. Lee et al. [45] showed that patients with diabetes had a higher risk of mild cognitive impairment that did those without. According to the diabetes fact sheet, the prevalence of dementia in patients with type 2 diabetes increased from 1.2% to 5.2% during 2006 to 2013 and was higher than in those without diabetes [12].

CONCLUSIONS

As the Korean population ages and the prevalence of diabetes increases, it will become increasingly crucial to find ways to overcome associated complications through good diabetes management. Diabetes self-management education is an important element of care for all those with diabetes and those at risk of developing the disease. However, only 39.4% of patients with diabetes have received comprehensive diabetes self-management education in Korea [7]. Therefore, a systematic approach to manage diabetes, including self-management education, is needed to prevent or delay complications. More concentrated efforts should be focused on early detection and management of diabetic complications and psychiatric disorders. The government needs to establish a long-term policy to address the growing burden posed by diabetes.

Conflict of interest
No potential conflict of interest relevant to this article was reported.

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