Greetings

This year marks the 10th anniversary of the Diabetes Fact Sheet published by the Korean Diabetes Association. The Korean Diabetes Association has gathered the best experts in diabetes research for the Diabetes Fact Sheet to provide accurate numbers, management status, and comorbidities of diabetes determined using national healthcare big data from the Korea National Health and Nutrition Examination Survey and National Health Insurance Service. The Diabetes Fact Sheet of the Korean Diabetes Association is more than simple academic research. The purpose of this fact sheet is to share valuable data that provides the opportunity for academics, the government, and patients to seek and discuss adequate measures to overcome diabetes prevalent in 16.7% of adults aged 30 or older in Korea. Through the Diabetes Fact Sheet, the Korean Diabetes Association promotes public awareness of diabetes and proposes policies while hosting in-depth discussions with various government agencies. In particular, the 'Diabetes Fact Sheet in Korea 2022' mainly presents (1) the importance of prediabetes detection and management, (2) diabetes management during COVID-19, and (3) diabetes management in older adults in a super-aged society.

The Korean Diabetes Association is devoting continuous efforts to improve the prevention and management of diabetes in Korea to an internationally outstanding level. We hope that the 'Diabetes Fact Sheet in Korea 2022' will serve as a valuable resource to help us achieve our goal.

President of KDA Sei Hyun Baik
Chairman Kyu Chang Won
## Organization

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Current status of diabetes

Prevalence of diabetes

Prevalence of diabetes by age

Diabetes population

Changes in the prevalence and population of diabetes in the recent 9 years

Prevalence of prediabetes

Population of prediabetes

Data Source: Korea National Health and Nutrition Examination Survey
Prevalence of diabetes (2018-2020)

The 2nd year of the 8th survey (2020) was suspended due to the COVID-19 pandemic. As a result, among 192 survey districts in the country, 180 have completed health interviews and health examinations (completion rate 93.8%), and 166 have completed nutrition surveys (completion rate 86.5%). Compared with the previous year, the number of eligible households and respondents decreased by 360 and 750, respectively.
As of 2020, 1 out of 6 adults (16.7%) aged 30 years or older has diabetes. The prevalence of diabetes among adults aged 30 years or older is 14.5% (1 out of 7 adults) based on fasting plasma glucose only. About 3 out of 10 adults aged 65 years or older (30.1%) have diabetes.

Diagnostic criteria for diabetes: At least one of the following four criteria

- Diagnosed with diabetes by a doctor
- Taking anti-diabetic medications
- Fasting plasma glucose (FPG) ≥126 mg/dL
- Glycosylated hemoglobin (HbA1c) ≥6.5%
Prevalence of diabetes by age group (2019-2020)

Among men with diabetes, those in their 50s accounted for the highest proportion (30.0%). Among women with diabetes, those aged 70 years or older accounted for the largest proportion (39.7%).

Diagnostic criteria for diabetes: At least one of the following four criteria ➀ Diagnosed with diabetes by a doctor ➁ Taking anti-diabetic medications ➂ Fasting plasma glucose ≥126 mg/dL ➃ Glycosylated hemoglobin ≥6.5%
Diabetes population (2019-2020)

Among adults aged 30 years or older, the number of people with diabetes is estimated to be 5.26 million. Approximately 240 thousand in their 30s and 680 thousand in their 40s have diabetes.
Changes in the prevalence and population of diabetes in the recent 9 years

Prevalence

- Total
- Men
- Women

Year:
2012: 11.8%
2013: 16.0%
2014: 15.4%
2015: 12.5%
2016: 15.8%
2017: 14.4%
2018: 15.1%
2019: 15.9%
2020: 16.7%

Total:
2013: 14.5%
2014: 13.0%
2015: 12.5%
2016: 13.0%
2017: 11.7%
2018: 11.8%
2019: 12.7%
2020: 14.3%
Diagnostic criteria for diabetes: At least one of the following four criteria

➀ Diagnosed with diabetes by a doctor
➁ Taking anti-diabetic medications
➂ Fasting plasma glucose ≥126 mg/dL
➃ Glycosylated hemoglobin ≥6.5%
Prevalence of prediabetes (2019-2020)

Approximately 4 out of 10 adults aged 30 years or older (44.3%) have prediabetes. Among adults aged 65 years or older, 1 out of 2 (50.4%) have prediabetes.

Diagnostic criteria for prediabetes: No prior diagnosis of diabetes with fasting plasma glucose 100-125 mg/dL or glycosylated hemoglobin 5.7-6.4%
Population of prediabetes (2019-2020)

Among adults aged 30 years or older, the number of people with prediabetes is estimated to be 14.97 million. The number of people with prediabetes tends to increase in their 30s and 50s and decrease in their 60s. Approximately 2.08 million adults in their 30s have prediabetes.
Current status in the management of diabetes

Management of diabetes
Glycemic control status
Glycosylated hemoglobin by age group
Management of diabetes (2019-2020)

Only 65.8% of adults aged 30 years or older with diabetes are aware of the disease, and 6 out of 10 are being treated for it. Only 25% of those receiving treatment have HbA1c <6.5%.

People with diabetes: People diagnosed with diabetes by a doctor or taking anti-diabetic medications, or with fasting plasma glucose ≥126 mg/dL, or with glycosylated hemoglobin (Hb1Ac) ≥6.5%

Awareness rate: Percentage of people previously diagnosed with diabetes by a doctor among people with diabetes (based on Hb1Ac)

Treatment rate: Percentage of people taking anti-diabetic medications among people with diabetes (based on Hb1Ac) (%)

Control rate: Percentage of people with HbA1c <6.5% among people with diabetes (based on Hb1Ac)
Glycemic control status (2019-2020)

1 out of 4 people with diabetes achieves glycosylated hemoglobin (HbA1c) <6.5%, and half of people with diabetes achieve HbA1c <7.0%.
1 out of 5 people with diabetes (19.5%) has HbA1c ≥8.0%, requiring treatment intensification.
The mean glycosylated hemoglobin (Hb1Ac) levels were higher in their 30s-40s, and in men than in women.
Comorbidities in diabetes

- Obesity in diabetes
- Abdominal obesity in diabetes
- Hypertension in diabetes
- Hypercholesterolemia in diabetes
- Hypertension and hypercholesterolemia in diabetes
- Comprehensive management of diabetes
- Self-management behaviors in diabetes
- Total energy intake, excess energy intake, and energy intake from macronutrients
Approximately half of the people with diabetes are obese, and 12.9% of people with diabetes have class II obesity or higher. 1.9% of people with diabetes have class III obesity with a body mass index of ≥35 kg/m².

People with diabetes: People diagnosed with diabetes by a doctor or taking anti-diabetic medications, or with fasting plasma glucose ≥126 mg/dL, or with glycosylated hemoglobin (Hb1Ac) ≥6.5%.

Obesity (based on body mass index) (kg/m²): ○ <18.5 Underweight ○ 18.5-22.9 Normal weight ○ 23.0-24.9 Overweight ○ 25.0-29.9 Class I obesity ○ 30.0-34.9 Class II obesity ○ ≥35.0 Class III obesity
Abdominal obesity in diabetes (2019-2020)

About 63.3% of people with diabetes have abdominal obesity, and the prevalence of abdominal obesity is higher in women than in men.

Abdominal obesity (based on waist circumference): Men ≥90 cm, Women ≥85 cm
Hypertension in diabetes (2019-2020)

58.6% of people aged 30 years or older with diabetes have hypertension. 7 out of 10 people aged 65 years or older with diabetes have hypertension. Only 1 out of 2 people 30 years older with diabetes achieves the treatment goal of blood pressure.

Prevalence of hypertension: Percentage of systolic blood pressure $\geq 140$ mmHg or diastolic blood pressure $\geq 90$ mmHg, or taking antihypertensive medications

Control rate of hypertension: Percentage of systolic blood pressure $<140$ mmHg and diastolic blood pressure $<85$ mmHg
Hypercholesterolemia in diabetes (2019-2020)

76.1% of people aged 30 years or older with diabetes have hypercholesterolemia. Only 53.5% of people with diabetes achieve the treatment goal of LDL cholesterol.

Prevalence of hypercholesterolemia: Percentage of circulating LDL cholesterol ≥100 mg/dL or taking cholesterol-lowering medications
Control rate of hypercholesterolemia: Percentage of circulating LDL cholesterol <100 mg/dL
Hypertension and hypercholesterolemia in people with diabetes (2019-2020)

Among people aged 30 years older with diabetes, 43.6% have both hypertension and hypercholesterolemia, and the prevalence of hypertension and hypercholesterolemia was higher in women than in men.

Diabetes: Diagnosed with diabetes by a doctor or taking anti-diabetic medications, or with fasting plasma glucose ≥126 mg/dL, or with glycosylated hemoglobin (Hb1Ac) ≥6.5%
Hypertension: Systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg, or taking antihypertensive medications
Hypercholesterolemia: Circulating LDL cholesterol ≥100 mg/dL or taking cholesterol-lowering medications

(Diabetes Metab J. 2022;46:417-26)
Comprehensive management of diabetes (2019-2020)

Less than (9.9%) of people aged 30 years or older with diabetes achieve all treatment goals of glycosylated hemoglobin (HbA1c), blood pressure, and LDL cholesterol. The rate is much lower in women than in men.

Comprehensive management: Achieving all goals of HbA1c <6.5%, blood pressure <140/85 mmHg, and LDL cholesterol <100 mg/dL
Self-management behaviors in diabetes (2019-2020)

22.3% of people with diabetes are current smokers. 22.8% of people with diabetes have high-risk alcohol consumption. 38.1% of people with diabetes walk regularly.

Self-management behaviors: Current smoking, high-risk alcohol consumption, regular walking

Current smoking: Having smoked 5 packs (or 100 cigarettes) in his or her lifetime and currently smoking cigarettes

High-risk alcohol consumption: More than 7 drinks twice a week for men and more than 5 for women

Regular walking: A minimum of 30 minutes a day of walking 5 or more days per week

(Diabetes Metab J. 2022;46:417-26)
Total energy intake, excess energy intake, and energy intake from macronutrients (2019-2020)

Total daily energy intake is lower in people with diabetes and diagnosed with diabetes than in those without diabetes.
The percentage of people with excess energy intake is lower in people with diabetes than in those without diabetes. The percentage of energy intake from protein and fat are also lower in people with diabetes and previously diagnosed with diabetes than in those without diabetes. However, the percentage of energy intake from carbohydrate is higher in people with diabetes and diagnosed with diabetes than in those without diabetes.

**Daily energy intake**

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<tr>
<th></th>
<th>Total</th>
<th>Men</th>
<th>Women</th>
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<tr>
<td>People with diabetes</td>
<td>2126.9</td>
<td>1824.6</td>
<td>1438.9</td>
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<td>People previously diagnosed with diabetes</td>
<td>2110.7</td>
<td>1785.0</td>
<td>1402.3</td>
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<tr>
<td>People without diabetes</td>
<td>2251.3</td>
<td>1911.1</td>
<td>1596.1</td>
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Estimated by a 24-hour dietary recall method in people with diabetes aged 30 years or older.
Excess energy intake: ≥125% of the estimated energy requirement
Percentage of energy intake from protein: (Protein intake×4) to {(protein intake×4)+(fat intake×9)+(carbohydrate intake×4)}
Percentage of energy intake from fat: (Fat intake×9) to {(protein intake×4)+(fat intake×9)+(carbohydrate intake×4)}
Percentage of energy intake from carbohydrate: (Carbohydrate intake×4) to {(protein intake×4)+(fat intake×9)+(carbohydrate intake×4)}
Current status of pharmacological treatment of diabetes

Current status of antidiabetic medications for the treatment of diabetes
Changes in the treatment rate with antidiabetic medications
Current status of oral combination therapy for diabetes
Trends in the prescription of antidiabetic medications
Current status of antidiabetic medications prescribed for the first time
Medication adherence for the treatment of diabetes

Data source: National Health Insurance Service
Adults aged 30 or older who are subscribed to the National Health Insurance Service and medical aid beneficiaries
Current status of antidiabetic medications for the treatment of diabetes (2019)

As of 2019, 3,900,596 patients are receiving antidiabetic medications. By age of which 1,150,542 are in their 60's, accounting for 30% of the total population undergoing diabetes treatment.
Changes in the treatment rate with antidiabetic medications

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<thead>
<tr>
<th>Year</th>
<th>Number of People</th>
<th>Treatment Rate</th>
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<td>929,119</td>
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<td>2003</td>
<td>1,143,278</td>
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<td>2004</td>
<td>1,289,338</td>
<td>4.5</td>
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<td>2005</td>
<td>1,534,813</td>
<td>5.2</td>
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<td>2006</td>
<td>1,702,834</td>
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<td>2007</td>
<td>1,847,772</td>
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<td>2008</td>
<td>1,991,783</td>
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<td>2009</td>
<td>2,152,177</td>
<td>6.8</td>
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<tr>
<td>2010</td>
<td>2,256,325</td>
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Treatment rate with antidiabetic medications among total population is steadily increasing from 3.4% in 2002 to 10.6% in 2019.

<table>
<thead>
<tr>
<th>Year</th>
<th>Treatment Rate (%)</th>
<th>Population</th>
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<tr>
<td>2011</td>
<td>7.5</td>
<td>2,436,043</td>
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<td>2012</td>
<td>7.8</td>
<td>2,575,395</td>
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<td>2013</td>
<td>8.0</td>
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<td>2014</td>
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<td>2015</td>
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<td>2016</td>
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<td>2017</td>
<td>9.6</td>
<td>3,439,552</td>
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<td>2018</td>
<td>10.1</td>
<td>3,655,146</td>
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<tr>
<td>2019</td>
<td>10.6</td>
<td>3,900,596</td>
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Current status of oral combination therapy for diabetes

![Bar chart showing the percentage of oral combination therapy for diabetes from 2002 to 2010.](image-url)
Oral combination therapy has gradually increased and exceeded 70% in 2008, showing a steady increase thereafter. In 2019, 77.8% of patients under antidiabetic medication treatment are receiving combination therapy of two or more medications.
Trends in the prescription of antidiabetic medications

*Insulin: Prescribed at least 3 times a year
Since 2010, metformin has become the most prescribed antidiabetic medication with a steadily increasing prescription rate. In 2019, metformin accounts for 87.5% of all antidiabetic medications. DPP-4 inhibitor has been the second most popular antidiabetic medication after metformin since 2015.

Current status of antidiabetic medications prescribed for the first time

Compared with 2009, the rate of dual or triple combination therapy as a first-time prescription for the treatment of diabetes has increased in 2019.

Treatment regimen of oral antidiabetic medications

Compared with 2009, the rate of dual or triple combination therapy as a first-time prescription for the treatment of diabetes has increased in 2019.
Compared with 2009, metformin is the dominant antidiabetic medication for a first-time prescription after diagnosis in 2019. The prescription rate of sulfonylureas has drastically decreased by 75%, while the prescription rate of DPP-4 has increased tenfold.
Medication adherence for the treatment of diabetes

Since 2010, the medication possession ratio for antidiabetic medications has steadily increased for 10 years, reaching 72.7% in 2019.

Medication possession ratio: Percentage of prescribing medications for ≥292 days a year (≥80%)
By age group
Current status of diabetes in people undergoing health examinations

Medication adherence for the treatment of diabetes by income level
Distribution of glycosylated hemoglobin levels
Hospital visit rates in people with newly diagnosed diabetes

Data source: National Health Insurance Service
Adults aged 30 years or older who are subscribed to the National Health Insurance Service and medical aid beneficiaries
Medication adherence for the treatment of diabetes by income level (2019)

Medication possession ratio for antidiabetic medications is the lowest (less than 70%) in the 1st (lowest) decile of income level.

**Medication possession ratio**: Percentage of prescribing medications for ≥292 days a year (≥80%)

**Income level**: Defined as health insurance premiums of National Health Insurance Service subscribers and medical aid beneficiaries
Distribution of fasting plasma glucose levels

The proportion of newly diagnosed diabetes through health examinations was 3% over the past decade. The proportion of population with impaired fasting glucose has steadily increased, accounting for 30% of all adults.

By year

- **People previously diagnosed with diabetes**
- **People with undiagnosed diabetes**
- **Impaired fasting glucose**
- **Normal**

People with undiagnosed diabetes: People with fasting plasma glucose ≥126 mg/dL on health examination but having not been prescribed antidiabetic medications.
The proportion of people with impaired fasting glucose and newly diagnosed people tends to increase with age.

By age group (2019)

- People previously diagnosed with diabetes
- People with undiagnosed diabetes
- Impaired fasting glucose
- Normal
People with newly diagnosed (or undiagnosed) diabetes: People with fasting plasma glucose ≥126 mg/dL on health examination but having not been prescribed antidiabetic medications
The rate of hospital visits within 6 months after diagnosis of diabetes was higher in people with obesity, abdominal obesity, dyslipidemia, hypertension, and chronic kidney disease than those without.
People in the 1st decile and employee-insured householders showed the lowest hospital visit rate within 6 months after diagnosis of diabetes.
The hospital visit rate was high among non-smokers and non-drinkers.
Major complications of diabetes

Leading causes of death
Vascular complications
Cancer

Changes in the incidence of end-stage kidney disease over the past decade
Changes in the incidence of proliferative diabetic retinopathy over the past decade

Leading causes of death, vascular complications, cancer:
People aged 30 years or older in 2009 undergoing general health examination, excluding those with type 1 diabetes

End-stage kidney disease, proliferative diabetic retinopathy:
People with diabetes aged 30 years or older

Data source: National Health Insurance Service
Adults aged 30 years or older who are subscribed to the National Health Insurance Service and medical aid beneficiaries
Leading causes of death

People with diabetes have a 1.55-times higher risk of death, a 1.56-times higher risk of cardiovascular death, and a 1.30-times higher risk of cancer death compared with healthy people.

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Total death

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
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<th>Diabetes</th>
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</thead>
<tbody>
<tr>
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<td>1.06</td>
<td>1.63</td>
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<td>(Hazard ratio)</td>
<td>1.00</td>
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<td></td>
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Death from cardiovascular disease

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<th>Diabetes</th>
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</thead>
<tbody>
<tr>
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<td>1.07</td>
<td>1.61</td>
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<tr>
<td>(Hazard ratio)</td>
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<tr>
<td></td>
<td>1.00</td>
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</table>

Death from cancer

<table>
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<tr>
<th></th>
<th>Normal</th>
<th>Impaired fasting glucose</th>
<th>Diabetes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazard ratio</td>
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</tr>
<tr>
<td>(Hazard ratio)</td>
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<tr>
<td></td>
<td>1.00</td>
<td>1.05</td>
<td>1.22</td>
</tr>
</tbody>
</table>

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People with diabetes have a 1.55-times higher risk of death, a 1.56-times higher risk of cardiovascular death, and a 1.30-times higher risk of cancer death compared with healthy people.
Vascular complications

Adults with prediabetes and diabetes are associated with a 1.05-times and a 1.59-times higher risk of myocardial infarction, respectively, compared to those with normoglycemia.
Adults with diabetes have a 1.70-times higher risk of ischemic stroke, a 1.51-times higher risk of heart failure, and a 4.95-times higher risk of end-stage kidney disease compared with nondiabetic adults.
Cancer

The risk of 10 most frequent cancers tends to increase in people with prediabetes and diabetes compared with healthy people.

**Thyroid cancer**

- Normoglycemia: Hazard ratio 1.00
- Impaired fasting glucose: Hazard ratio 1.00
- Diabetes: Hazard ratio 1.03

**Lung cancer**

- Normoglycemia: Hazard ratio 1.00
- Impaired fasting glucose: Hazard ratio 0.99
- Diabetes: Hazard ratio 1.08

**Stomach cancer**

- Normoglycemia: Hazard ratio 1.00
- Impaired fasting glucose: Hazard ratio 0.99
- Diabetes: Hazard ratio 1.05

**Colorectal cancer**

- Normoglycemia: Hazard ratio 1.00
- Impaired fasting glucose: Hazard ratio 1.10
- Diabetes: Hazard ratio 1.41

**Breast cancer**

- Normoglycemia: Hazard ratio 1.00
- Impaired fasting glucose: Hazard ratio 1.04
- Diabetes: Hazard ratio 1.04
Top 10 most common cancers registered in the Korea Central Cancer Registry, 2019
Changes in the incidence of end-stage kidney disease over the past decade

Incidence: Number of cases per 1,000 people standardized by sex and age based on data from the 2010 Population and Housing Census.
Changes in the incidence of proliferative diabetic retinopathy over the past decade

The incidence of proliferative diabetic retinopathy is gradually decreasing in people with diabetes. In 2019, 7 out of 1,000 people with diabetes suffered proliferative diabetic retinopathy.

Incidence: Number of cases per 1,000 people standardized by sex and age based on data from the 2010 Population and Housing Census
Data source and method of analysis – Korea National Health and Nutrition Examination Survey (KNHANES)

Subjects
• Adults aged 19 years or older who completed the KNHANES from 2012 to 2020.

Classification and diagnostic criteria
• Diabetes: Diagnosed with diabetes by a doctor or taking antidiabetic medications or with fasting plasma glucose ≥126 mg/dL, or with glycosylated hemoglobin (HbA1c) ≥6.5%
• Prediabetes: No prior diagnosis of diabetes with fasting plasma glucose 100-125 mg/dL or Hb1Ac 5.7-6.4%.
• Normal: None of the above criteria satisfied

All indicators, except for the prevalence of diabetes, were analyzed by integrating data from 2019 to 2020.
Data source and method of analysis - National Health Insurance Service (NHIS)

Data source
• Data from 2002 to 2019 provided by the NHIS were used.
• Claim data: Collected from people aged 30 years or older who were eligible for health insurance.
• Examination data: Collected from people aged 30 years or older who underwent general health examinations conducted by the NHIS.

Type 2 diabetes
• Claim data: ICD-10 code E11-14 with claims of antidiabetic medications
• Examination data: Satisfying the definition of diabetes in the claim data or fasting plasma glucose ≥126mg/dL

Comorbidities
• Obesity: Body mass index ≥25.0 kg/m²
• Abdominal obesity: Waist circumference ≥90 cm for men and ≥85 cm for women
• Hypercholesterolemia: ICD-10 code E78 with claims of lipid-lowering medications or LDL cholesterol ≥100 mg/dL
• Hypertension: ICD-10 code I10-13 and I15 with claims of anti-hypertensive medications or systolic blood pressure ≥140 mmHg, or diastolic blood pressure ≥90 mmHg
• Chronic kidney disease: Estimated glomerular filtration rate <60 mL/min/1.73 m² (by the MDRD formula)

Self-management behavior
Smoking
• Current smoking: Having smoked 5 packs (100 cigarettes) in his or her lifetime and currently smoking cigarettes
• Ex-smoking: Having smoked 5 packs (100 cigarettes) in his or her lifetime and currently not smoking cigarettes
• Non-smoking: Having not smoked 5 packs (100 cigarettes) in his or her lifetime

Drinking
• Drinking: Currently consuming alcohol
• Non-drinking: Currently not consuming alcohol

Regular exercise
• Yes: Engaging in vigorous exercise for at least 20 minutes a day for 3 days or moderate exercise for at least 30 minutes a day for 5 days in the last 1 week
• No: Having not satisfied the criteria in the last 1 week
Complications

- Myocardial infarction: Having been hospitalized with ICD-10 codes I21 and I22
- Ischemic stroke: Having been hospitalized with ICD-10 codes I63 and I64 and claims of brain computed tomography or magnetic resonance imaging
- Heart failure: Having been hospitalized with ICD-10 code I50
- Cancer: Having ICD-10 code C00-98 and a special identification code for rare disease, including V193 (registered cancer patient) claimed together
- Thyroid cancer: C73 / Lung cancer: C33, C34 / Stomach cancer: C16 / Colorectal cancer: C18, C19, C20 / Breast cancer: C50 / Prostate cancer: C61 / Liver cancer: C22 / Pancreatic cancer: C25 / Gallbladder and other bile tract cancers: C23, C24 / Kidney cancer: C64
- End-stage kidney disease: Claims of special identification codes for rare disease, including V001 (day of artificial kidney dialysis), V003 (day of continuous ambulatory peritoneal dialysis or peritoneal fluid perfusion), and V005 (kidney transplantation and directly related inpatient and outpatient treatment)
- Proliferative diabetic retinopathy: Having undergone laser photocoagulation or vitrectomy after claims of ICD-10 code H36.0

Leading causes of death, vascular complications, and cancer were followed up and analyzed from the date of health examination in 2009 to December 31, 2019, excluding cases reported before the specified date. Each hazard ratio was presented using a Cox proportional hazards model adjusted for age and sex.

MDRD: Modification of Diet in Renal Disease / ICD-10: International Classification of Diseases, 10th Revision
Appendix

Changes in the incidence of severe hypoglycemia
Parkinson’s disease in patients with type 2 diabetes
Risk of cardiovascular disease by depression in people with type 2 diabetes
Dementia in people with type 2 diabetes
Gestational diabetes
Mortality and causes of death in people with type 2 diabetes
Changes in the incidence of severe hypoglycemia

Trends in the prevalence and incidence of severe hypoglycemia

Trends in the total number experiencing severe hypoglycemia

Database: National Health Insurance Service, health insurance claim data of adults with type 2 diabetes over the age of 30 (2002-2019)
Severe hypoglycemia: Emergency room visit with hypoglycemia (ICD-10 code E16)
As of 2019, the prevalence of severe hypoglycemia was 0.6%. Every year, 4.43 per 1,000 people with type 2 diabetes, approximately 23,000 people, develop severe hypoglycemia.
Parkinson’s disease in patients with type 2 diabetes

As of 2016, 31,577 patients with type 2 diabetes had Parkinson’s disease. Compared with health people, people who have impaired fasting glucose and, diabetes for less than 5 years, and diabetes for more than 5 years have a 1.04-fold, 1.19-fold, and 1.62-fold higher risk of Parkinson’s disease, respectively.

Database: 8,443,551 adults receiving National Health Insurance Service Health Examination (2009-2010)
Parkinson’s disease definition: Diagnosis of disease code V124 by an expert
Risk of cardiovascular disease by depression in people with type 2 diabetes

People with type 2 diabetes who have depression have a 1.54-times higher risk of stroke, a 1.38-times higher risk of myocardial infarction, and a 1.66-times higher risk of death compared with people with type 2 diabetes who do not have depression.

Database: National Health Insurance Service health examination data, 2,228,443 people with type 2 diabetes who underwent health examinations between 2009 and 2012.

Depression: ICD-10 codes F32, F33
Classification of depression: Temporary depression (1 report of depression), persistent depression (≥2 reports of depression)
Myocardial infarction: ICD-10 codes I21, I22 + history of hospitalization
Stroke: ICD-10 codes I63, I64 + history of hospitalization + brain magnetic resonance imaging or brain computed tomography scan
ND: no depression, TD: transient depression, PD: persistent depression

(Database Metab J. 2021;45:379-89)
Dementia in people with type 2 diabetes

Incidence of dementia

Database: people with diabetes over the age of 40, National Health Insurance Service health insurance claim data (2009-2015)
Dementia: Dementia medication + disease code (ICD-10 codes F00-F03, G30, G31)
Alzheimer disease: ICD-10 codes F00, G30
The incidence of dementia, Alzheimer's disease, and vascular dementia is 9.5, 6.8, and 1.3 per 1,000 people per year, respectively. Young-onset dementia accounts for approximately 4.8% of total dementia with mostly vascular dementia. Alzheimer’s disease tends to be the dominant type of late-onset dementia.

**Incidence of Alzheimer’s disease**

- Total: 54.44
- Men: 50.02
- Women: 52.45

**Incidence of vascular dementia**

- Total: 6.77
- Men: 6.65
- Women: 6.87

**Classification of Young-onset dementia and late-onset dementia:** Disease onset before or after 65 years of age

Vascular dementia: ICD-10 code F01

(Diabetes Metab J. 2020;44:113-24)
Gestational diabetes

Prevalence of gestational diabetes according to age

- Age (yr) - Prevalence (%)
  - <25 - 4.89
  - 25-29 - 8.36
  - 30-34 - 15.57
  - 35-39 - 19.42
  - ≥40 - 22.46

Prevalence of gestational diabetes according to prepregnancy body mass index

- Prepregnancy body mass index (kg/m²) - Prevalence (%)
  - <18.5 - 10.57
  - 18.5-22.9 - 11.96
  - 23.0-24.9 - 15.31
  - 25.0-29.9 - 18.07
  - ≥30.0 - 24.53

*Database:* National Health Insurance Service data (2011-2015), pregnant women who received a health examination one year before pregnancy.
The prevalence of gestational diabetes from 2011 to 2015 was 12.7%. The incidence of gestational diabetes increased with age at the time of pregnancy, body mass index, waist circumference, and fasting plasma glucose levels.

**Prevalence of gestational diabetes according to waist circumference**

<table>
<thead>
<tr>
<th>Waist circumference (cm)</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;65</td>
<td>10.63</td>
</tr>
<tr>
<td>65-74</td>
<td>12.10</td>
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<tr>
<td>75-84</td>
<td>15.47</td>
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<tr>
<td>85-94</td>
<td>18.97</td>
</tr>
<tr>
<td>≥95</td>
<td>23.23</td>
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**Prevalence of gestational diabetes according to fasting plasma glucose categories**

<table>
<thead>
<tr>
<th>Fasting plasma glucose (mg/dL)</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;65</td>
<td>10.40</td>
</tr>
<tr>
<td>65-74</td>
<td>11.50</td>
</tr>
<tr>
<td>75-84</td>
<td>13.71</td>
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<tr>
<td>85-94</td>
<td>18.29</td>
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<tr>
<td>90-99</td>
<td>18.29</td>
</tr>
<tr>
<td>100-109</td>
<td>24.69</td>
</tr>
<tr>
<td>110-125</td>
<td>24.69</td>
</tr>
</tbody>
</table>

*P for trend <0.05*

**Gestational diabetes:** Having not been diagnosed with diabetes before pregnancy and have been treated twice or more for gestational diabetes (ICD-10 codes O24.4, O24.9)

(Endocrinal Metab. 2021;36:628-36)
Mortality and causes of death in people with type 2 diabetes

Standardized all-cause mortality by sex and age

1000 person-years

Age(year) Age(year)

Men Women

1000 person-years

Age(year) Age(year)

Overall

30-34 6.15 6.65
35-39 4.27 6.01
40-44 3.33 3.82
45-49 2.95 3.13
50-54 2.46 2.60
55-59 2.35 3.26
60-64 2.41 3.38
65-69 2.35 3.06
70-74 2.03 2.83
75-79 1.78 2.43
80+ 1.23 1.33
Overall 2.20 2.54
The mortality of people with type 2 diabetes was 23.8% for 12 years from 2002 to 2013. Mortality increases with age and is higher in men than in women across all age groups. The main causes of death in people with type 2 diabetes are malignant neoplasm, diabetes, and cardiovascular disease (men: malignant neoplasm > diabetes > cardiovascular disease, women: cardiovascular disease > diabetes > malignant neoplasm).

Diseases or conditions directly leading to death were adopted as the specific causes of death, and accordingly, they were classified as the following ICD-10 codes: Malignant neoplasm (C00-97), diabetes mellitus (E11-14), diseases of the circulatory system (I00-99) and other causes. Among the deaths due to diseases of the circulatory system (I00-99), deaths due to ischemic heart diseases (I20-25), and cerebrovascular diseases (I60-69) were further analyzed.
In both men and women, diabetes had the highest standardized mortality rate by cause of death classified by disease.

**Total mortality according to causes of death classified by disease codes**

- **Diabetes**
- **Diseases of the circulatory system**
- **Malignant neoplasm**
- **Other causes**

**Database:** National Health Insurance Service data (2002-2013), adults with type 2 diabetes

**Mortality:** Number of deaths/number of years alive

**Standardized mortality ratio:** Number of observed deaths/number of expected deaths