dmj
DIABETES & METABOLISM JOURNAL

Diabetes Fact Sheet 2025: Special Edition on Diabetes with Obesity and in Pregnancy

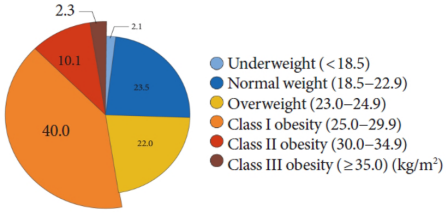
Se Eun Park, Se Hee Min, Jin Hwa Kim, Seung-Hwan Lee, Han Na Jung, Joon Ho Moon, Kyungdo Han, Seung-Hyun Ko, Bong Soo Cha, Sung Hee Choi

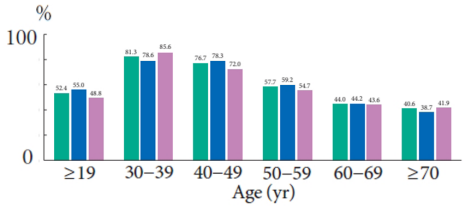
Diabetes Metab J 2026;50:255-266 | *https://doi.org/10.4093/dmj.2025.1162*

Diabetes Fact Sheet 2025
Special Edition on Diabetes with Obesity and in Pregnancy

Prevalence of obesity among adults with diabetes

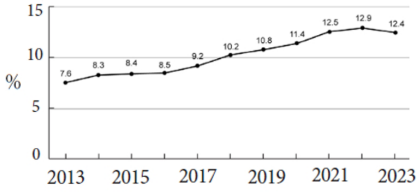
Prevalence
52.4%
Number
2.67 million





Prevalence of gestational diabetes mellitus

Prevalence
12.4%
Number
26,089



Conclusion

- Obesity, especially abdominal obesity, is highly prevalent and increasing among Korean adults with diabetes, particularly in younger individuals.
- Diabetes in pregnancy is also rising, emphasizing the need for early weight-focused prevention.

Highlights

- **Obesity and abdominal obesity are highly prevalent among Korean adults with diabetes, with abdominal obesity steadily increasing over the past decade.**
- **Younger adults with diabetes show disproportionately higher obesity rates, indicating an emerging high-risk population.**
- **Diabetes in pregnancy has risen despite declining birth rates, driven by older maternal age and pre-pregnancy obesity.**
- **Women with prior gestational diabetes have a markedly increased risk of developing postpartum type 2 diabetes.**

How to cite this article:
Park SE, Min SH, Kim JH, Lee SH, Jung HN, Moon JH, et al. Diabetes Fact Sheet 2025: Special Edition on Diabetes with Obesity and in Pregnancy. Diabetes Metab J 2026;50:255-266. https://doi.org/10.4093/dmj.2025.1162

Original Article
Guideline/Statement/Fact Sheet

Diabetes Metab J 2026;50:255-266
https://doi.org/10.4093/dmj.2025.1162
pISSN 2233-6079 · eISSN 2233-6087

dmj
DIABETES & METABOLISM JOURNAL

Diabetes Fact Sheet 2025: Special Edition on Diabetes with Obesity and in Pregnancy

Se Eun Park[1,*], Se Hee Min[2,*], Jin Hwa Kim[3], Seung-Hwan Lee[4], Han Na Jung[5], Joon Ho Moon[6], Kyungdo Han[7], Seung-Hyun Ko[8], Bong Soo Cha[9], Sung Hee Choi[6]

[1]Division of Endocrinology and Metabolism, Department of Internal Medicine, Kangbuk Samsung Hospital, Sungkyunkwan University School of Medicine, Seoul, Korea
[2]Division of Endocrinology and Metabolism, Department of Internal Medicine, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea
[3]Department of Endocrinology and Metabolism, Chosun University Hospital, Chosun University College of Medicine, Gwangju, Korea
[4]Division of Endocrinology and Metabolism, Department of Internal Medicine, Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Seoul, Korea
[5]Division of Endocrinology and Metabolism, Department of Internal Medicine, College of Medicine, Hallym University, Chuncheon, Korea
[6]Division of Endocrinology and Metabolism, Department of Internal Medicine, Seoul National University Bundang Hospital, Seoul National University College of Medicine, Seongnam, Korea
[7]Department of Statistics and Actuarial Science, Soongsil University, Seoul, Korea
[8]Division of Endocrinology and Metabolism, Department of Internal Medicine, St. Vincent's Hospital, College of Medicine, The Catholic University of Korea, Seoul, Korea
[9]Division of Endocrinology and Metabolism, Department of Internal Medicine, Yonsei University College of Medicine, Seoul, Korea

Background: We evaluated epidemiologic trends and clinical characteristics in Koreans with diabetes and obesity and in those with diabetes in pregnancy.
Methods: We analyzed Korea National Health and Nutrition Examination Survey data (2012–2023) to assess obesity trends in people with diabetes and used the Korean National Health Insurance Service database (2013–2023) to evaluate diabetes in pregnancy.
Results: Among Korean adults with diabetes (≥19 years), 52.4% had obesity and 61.1% had abdominal obesity. Only 39.9% achieved the glycemic target (glycosylated hemoglobin <6.5%). The obesity prevalence was higher in younger age groups, and abdominal obesity showed an upward trend over the last 12 years. Diabetes in pregnancy increased despite declining total births, with gestational diabetes mellitus (GDM) rising from 7.6% to 12.4%, and pregestational diabetes from 0.9% to 2.1%, reflecting older maternal age and pre-pregnancy obesity. Women with prior GDM had a higher risk of postpartum type 2 diabetes mellitus (hazard ratio, 6.07; 95% confidence interval, 5.97 to 6.17).
Conclusion: Obesity and abdominal obesity are highly prevalent among Korean adults with diabetes, with abdominal obesity increasing over the past decade, and obesity disproportionately affects younger adults. Diabetes in pregnancy has also increased with older maternal age and worsening pre-pregnancy metabolic health, underscoring the need for early weight-focused prevention.

Keywords: Diabetes mellitus; Obesity; Pregnancy; Prevalence; Republic of Korea

Corresponding authors: Bong Soo Cha https://orcid.org/0000-0003-0542-2854
Division of Endocrinology and Metabolism, Department of Internal Medicine, Yonsei University College of Medicine, 50-1 Yonsei-ro, Seodaemun-gu, Seoul 03722, Korea
E-mail: BSCHA@yuhs.ac

Sung Hee Choi https://orcid.org/0000-0003-0740-8116
Division of Endocrinology and Metabolism, Department of Internal Medicine, Seoul National University Bundang Hospital, Seoul National University College of Medicine, 82 Gumi-ro 173beon-gil, Bundang-gu, Seongnam 13620, Korea
E-mail: drshchoi@snu.ac.kr

*Se Eun Park and Se Hee Min contributed equally to this study as first authors.

Received: Nov. 17, 2025; Accepted: Jan. 20, 2026

INTRODUCTION

Type 2 diabetes mellitus (T2DM) has risen in parallel with the obesity epidemic worldwide, driving major burdens of morbidity, disability, and mortality [1]. Shared pathophysiological mechanisms—insulin resistance, adipokine dysregulation, chronic inflammation, and alterations in the gut microbiota—accelerate systemic metabolic disturbance and increase cardiovascular risk [2]. Obesity remains a key modifiable determinant of T2DM and its complications [3].

A recent national report, 'Diabetes Fact Sheet in Korea 2024' highlights the increased burden of obesity among people with diabetes, with particularly the high co-occurrence in younger adults in Korea [4]. These trends underscore the need for a weight-centric approach to diabetes care, as a well-planned weight reduction strategy is essential to change the course of diabetes with obesity [5]. The Korean Diabetes Association (KDA) also updated its guidelines for diabetes management to recommend that adults with T2DM and obesity should aim to lose weight and maintain the reduction, and anti-obesity medications should be considered as adjuncts to lifestyle modification to support systematic weight reduction [6]. Thus, understanding the prevalence and the current trajectory of obesity in diabetic populations is critically important for effective clinical and public health management.

Diabetes in pregnancy, encompassing pregestational diabetes mellitus (PGDM) and gestational diabetes mellitus (GDM), has also emerged as a growing public health concern in the context of the worsening metabolic health among women of reproductive age [7,8]. The global prevalence of diabetes in pregnancy has risen alongside increases in maternal age and pre-pregnancy obesity, as well as higher background rates of T2DM [9]. These trends reflect the combined impact of delayed childbearing, rising pre-pregnancy body mass index (BMI), and population-level shifts toward insulin resistance and central adiposity [10-12]. Diabetes in pregnancy is clinically important not only because it increases the risk of adverse obstetric and neonatal outcomes but also because it marks a critical window for identifying women at elevated long-term risk of T2DM and cardiometabolic diseases [13,14]. Importantly, accumulating evidence suggests that exposure to maternal hyperglycemia and dysmetabolism *in utero* may have lasting metabolic consequences in the offspring, including increased risks of childhood adiposity and obesity, as well as future glucose intolerance and T2DM. From Korean study, pre-pregnancy obesity and weight gain during pregnancy is also important on the metabolic consequence of offsprings [15-19]. Previous studies have shown that women with prior GDM have a nearly 10-fold higher risk of developing T2DM later in life, and those with PGDM face substantial risks of preeclampsia, fetal overgrowth, and perinatal complications, including congenital anomalies [20,21]. Thus, monitoring the recent trends and clinical characteristics of diabetes in pregnancy provides key insights into the intergenerational transmission of metabolic risk and the effectiveness of current prevention, screening, and follow-up strategies.

Since 2012, the KDA has published annual Diabetes Fact Sheets using data from the Korea National Health and Nutrition Examination Survey (KNHANES), a nationwide survey conducted by the Korea Disease Control and Prevention Agency [22]. These Fact Sheets aim to raise awareness of diabetes and its comorbidities and to inform national health policy. Accordingly, this study updates recent trends in the prevalence of obesity among Korean adults with diabetes based on the 2024 Diabetes Fact Sheet [4].

Using nationally representative data from KNHANES and the Korean National Health Insurance Service (NHIS), we examined the prevalence, recent trends, and clinical characteristics of obesity in Korean adults with diabetes to generate comprehensive national estimates of the current burden. We also specifically assessed diabetes in pregnancy. Using the NHIS dataset, we also examined recent trends in diabetes in pregnancy and its related risk factors, including maternal age and pre-pregnancy metabolic profiles. In addition, we evaluated the long-term risk of T2DM among women with a history of GDM to characterize postpartum metabolic outcomes at the population level.

METHODS

Study design and data collection

This study analyzed data from the KNHANES, a nationally representative cross-sectional survey designed to evaluate the health and nutritional status of the Korean population [23]. KNHANES 2012–2023 data informed the estimates of the overall prevalence and recent trends among adults aged ≥19 years, whereas KNHANES 2022–2023 data were used to evaluate the current prevalence and management status.

To analyze diabetes in pregnancy, we analyzed the delivery records of 3,451,648 women using claims data from 2013 to

2023, derived from the Korean NHIS database, to estimate the prevalence of diabetes in pregnancy. To evaluate changes in maternal age, BMI, waist circumference (WC), and fasting plasma glucose (FPG) before pregnancy, only women who had undergone a health screening within the two years prior to conception were included. For the analysis of the long-term risk of T2DM after delivery, we included women who gave birth between 2003 and 2013, excluding those with missing data or a prior diagnosis of diabetes, resulting in a final cohort of 3,061,361 women.

This study was approved by the Institutional Review Board of Sungkyunkwan University Kangbuk Samsung Hospital (IRB No. 2025-11-012) and Seoul National University Bundang Hospital (X-2406-906-902). The board waived the requirement for informed consent.

Definitions of diabetes mellitus, obesity, and abdominal obesity

In analyses using the KNHANES database, diabetes mellitus was defined as FPG ≥126 mg/dL, glycosylated hemoglobin (HbA1c) ≥6.5%, a previous diagnosis of diabetes mellitus, or current use of antidiabetic medications [24].

The BMI (kg/m²) was categorized according to the criteria of the Korean Society for the Study of Obesity as follows: underweight (<18.5), normal weight (18.5–22.9), overweight (23.0–24.9), and obese (≥25.0). Obesity was further classified as follows: underweight (BMI <18.5 kg/m²), normal weight (BMI 18.5–22.9 kg/m²), overweight (BMI 23.0–24.9 kg/m²), class I obesity (BMI 25.0–29.9 kg/m²), class II obesity (BMI 30.0–34.9 kg/m²), and class III obesity (BMI ≥35.0 kg/m²) [25]. Abdominal obesity was defined as a WC ≥90 cm in men and ≥85 cm in women [25].

Definition of diabetes in pregnancy

GDM was defined as using any prescription for insulin during pregnancy or the presence of International Classification of Diseases, 10th Revision (ICD-10) codes O24.4 or O24.9 documented at least once within 2 months prior to delivery in the absence of PGDM. In Korea, the diagnosis of GDM is typically based on a two-step screening strategy, consisting of an initial 50-g glucose challenge test followed, when positive, by a diagnostic 100-g oral glucose tolerance test (OGTT). PGDM was defined as any diagnosis of diabetes (ICD-10 codes E10–E14) and a prescription for antidiabetic medication before delivery. Postpartum T2DM was defined as any diagnosis of T2DM (ICD-10 codes E11–E14) together with a prescription for antidiabetic medication after delivery.

Statistical analysis

Statistical analyses utilized the KNHANES database, accounting for its complex sampling design and sampling weights [23], ensuring nationally representative prevalence estimates. The estimated prevalence of obesity and abdominal obesity among individuals with diabetes was presented overall and by age group as percentages, along with the corresponding estimated numbers of individuals in the population.

Similarly, the prevalence of diabetes in pregnancy was assessed annually from 2013 to 2023. Recent trends in maternal characteristics, including the age at delivery, pre-pregnancy BMI, WC, and FPG, were also evaluated among women who gave birth during the same period. Furthermore, we evaluated the long-term risk of incident T2DM among women who gave birth between 2003 and 2013 by applying Cox proportional hazards models, with hazard ratios and corresponding 95% confidence intervals (CIs) calculated. The follow-up period extended from the date of delivery to the occurrence of the outcome or December 31, 2023, using women without diabetes in pregnancy as the reference group. The model was adjusted for maternal age at delivery, and subgroup analyses were performed according to insulin use during the GDM period and maternal age at delivery. All analyses were performed using SAS software version 9.4 (SAS Institute, Cary, NC, USA) and R version 3.2.3 (The R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

Prevalence of obesity and abdominal obesity among adults with diabetes

Among Korean adults aged ≥19 years with diabetes, an estimated 2.67 million—52.4% overall (55.0% in men and 48.8% in women)—had obesity in 2022–2023. Among individuals with diabetes, the prevalence of obesity was highest in those in their 30s and 40s—81.3% and 76.7%, respectively—and decreased with increasing age. Similar patterns were observed in both men and women. The estimated prevalence of abdominal obesity among individuals with diabetes was 3.02 million, corresponding to a prevalence of 61.1% (60.2% in men and 62.4% in women) (Table 1, Fig. 1A and B). For the weight-status distribution among individuals with diabetes, class I obesity was

Table 1. Estimated prevalence of obesity and abdominal obesity among adults with diabetes, KNHANES 2022 to 2023

Variable	Obesity			Abdominal obesity		
	Total	Men	Women	Total	Men	Women
By age group, yr						
≥19	52.4 (2,667,007)	55.0 (1,644,630)	48.8 (1,022,377)	61.1 (3,021,401)	60.2 (1,741,883)	62.4 (1,279,519)
≥30	51.5 (2,564,530)	53.7 (1,553,770)	48.5 (1,010,761)	60.3 (2,918,925)	59.0 (1,651,023)	62.2 (1,267,902)
≥65	42.0 (910,860)	41.2 (421,586)	42.7 (489,273)	59.9 (1,276,921)	55.5 (556,475)	63.9 (720,446)
30–39	81.3 (142,857)	78.6 (85,148)	85.6 (57,709)	70.1 (121,610)	66.6 (72,161)	75.8 (49,449)
40–49	76.7 (397,454)	78.3 (303,756)	72.0 (93,698)	75.8 (373,194)	75.0 (273,724)	78.2 (99,470)
50–59	57.7 (784,877)	59.2 (536,372)	54.7 (248,505)	58.3 (761,662)	58.2 (506,055)	58.3 (255,607)
60–69	44.0 (668,080)	44.2 (401,169)	43.6 (266,911)	55.4 (826,210)	55.0 (487,209)	55.9 (339,001)
≥70	40.6 (571,264)	38.7 (227,325)	41.9 (343,939)	60.8 (836,248)	54.5 (311,873)	65.4 (524,375)

Values are presented as number (%).
KNHANES, Korea National Health and Nutrition Examination Survey.

most common (40.0%, 2.04 million); class II and class III obesity had a prevalence of 10.1% (0.52 million) and 2.3% (0.12 million), respectively (Fig. 1C-E) (Supplementary Table 1).

Trends in the prevalence of obesity and abdominal obesity among adults with diabetes

Based on the KNHANES 2002–2023 data, about half of the individuals with diabetes had obesity and abdominal obesity. Over the past 12 years, the general obesity prevalence remained relatively stable, but abdominal obesity showed an increasing trend. Among men with diabetes, the prevalence of both general and abdominal obesity increased, whereas among women, the prevalence of general obesity has recently stabilized, while that of abdominal obesity has continued to rise (Fig. 2A-C).

Across the most recent 12 years, the BMI in the diabetic population has remained stable, while the WC has increased. Increases in WC were more clearly observed among men with diabetes (Fig. 2D-F). In addition, when stratified by age group (19–39, 40–64, and ≥65 years), temporal trends differed by age; however, the pattern of higher BMI in women compared with men was consistent across age groups (Supplementary Fig. 1).

Glycemic status in adults with diabetes and obesity

In individuals with diabetes and obesity, the proportions according to the HbA1c category were 39.9% (<6.5%), 23.9% (6.5%–6.9%), 20.0% (7.0%–7.9%), 6.6% (8.0%–8.9%), 4.7% (9.0%–9.9%), and 4.8% (≥10%).

Trends in the prevalence of diabetes in pregnancy

The prevalence of diabetes in pregnancy was analyzed over a 10-year period from 2013 to 2023 (Fig. 3). Although the total number of annual deliveries markedly declined from 401,435 in 2013 to 209,822 in 2023, the number of women diagnosed with GDM decreased only modestly, from 30,377 to 26,089. Consequently, the proportion of GDM among all deliveries increased substantially, from 7.6% to 12.4% (Fig. 3A). Meanwhile, the prevalence of PGDM showed a concurrent rise in both the absolute number of cases and their relative proportion, increasing from 3,788 (0.9%) in 2013 to 4,294 (2.1%) in 2023 (Fig. 3B).

Current trends in pre-pregnancy clinical and metabolic profiles among pregnant women in Korea

The mean maternal age at delivery increased steadily over the past decade, from 31.8 years in 2013 to 33.5 years in 2023 (Fig. 4A). A similar upward trend was observed across all groups. However, women with GDM were consistently older than those without diabetes, with the mean age rising from 33.0 to 34.5 years. Women with PGDM had even higher maternal ages, increasing from 34.0 to 35.5 years during the same period. The pre-pregnancy BMI also showed a gradual increase from 21.1 kg/m² in 2013 to 22.3 kg/m² in 2023, with higher mean values among women with GDM (from 21.8 to 23.4 kg/m²) and PGDM (from 24.2 to 26.6 kg/m²) (Fig. 4B). Consistent increases were observed in WC, which rose from 70.3 cm in 2013 to 72.4 cm in 2023 in the overall population (Fig. 4C). Women with GDM had larger WC and showed a larger increase over

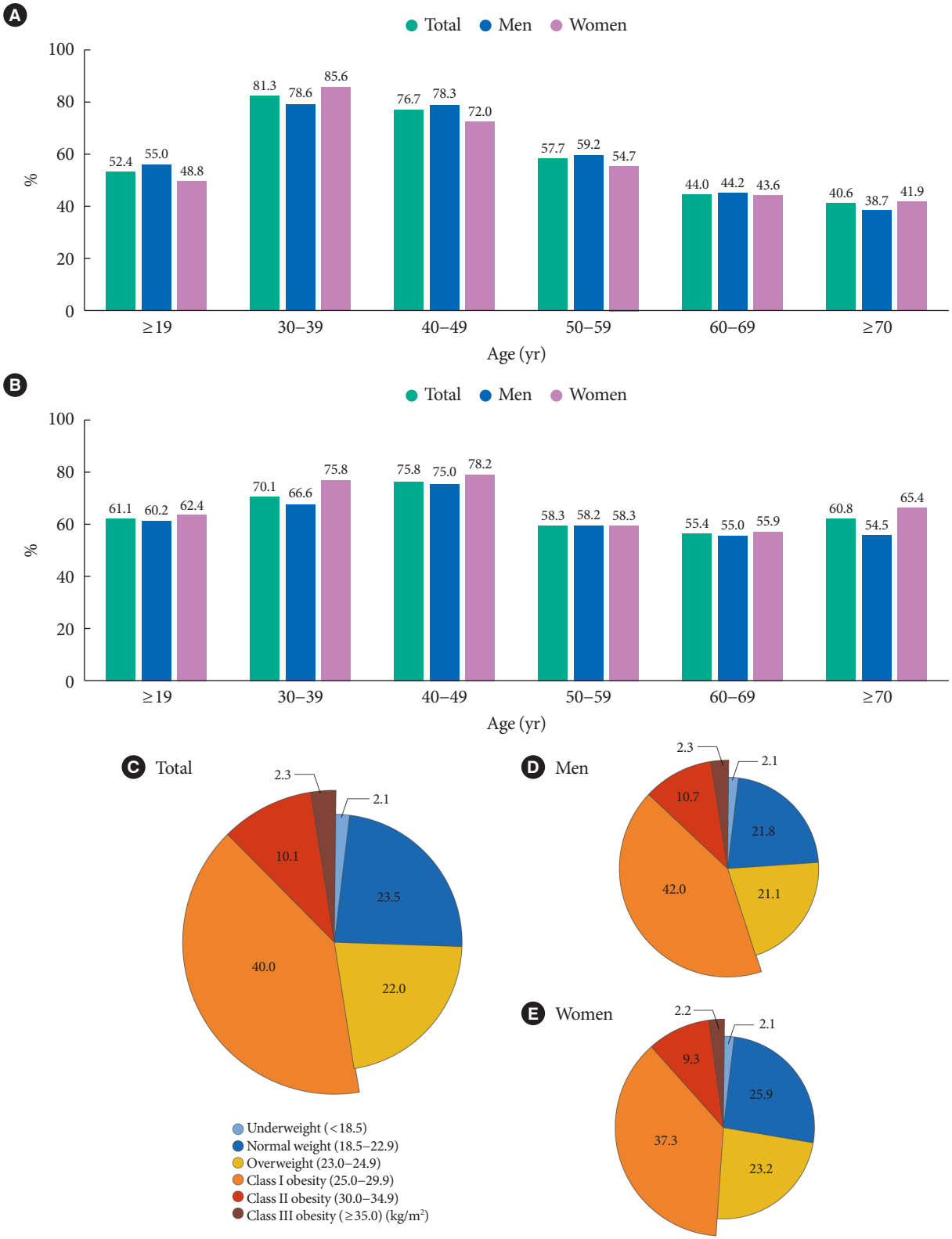


Fig. 1. Estimated prevalence of (A) obesity and (B) abdominal obesity, overall and by age group, and obesity by obesity class—(C) total, (D) men, (E) women—among adults with diabetes, Korea National Health and Nutrition Examination Survey 2022–2023.

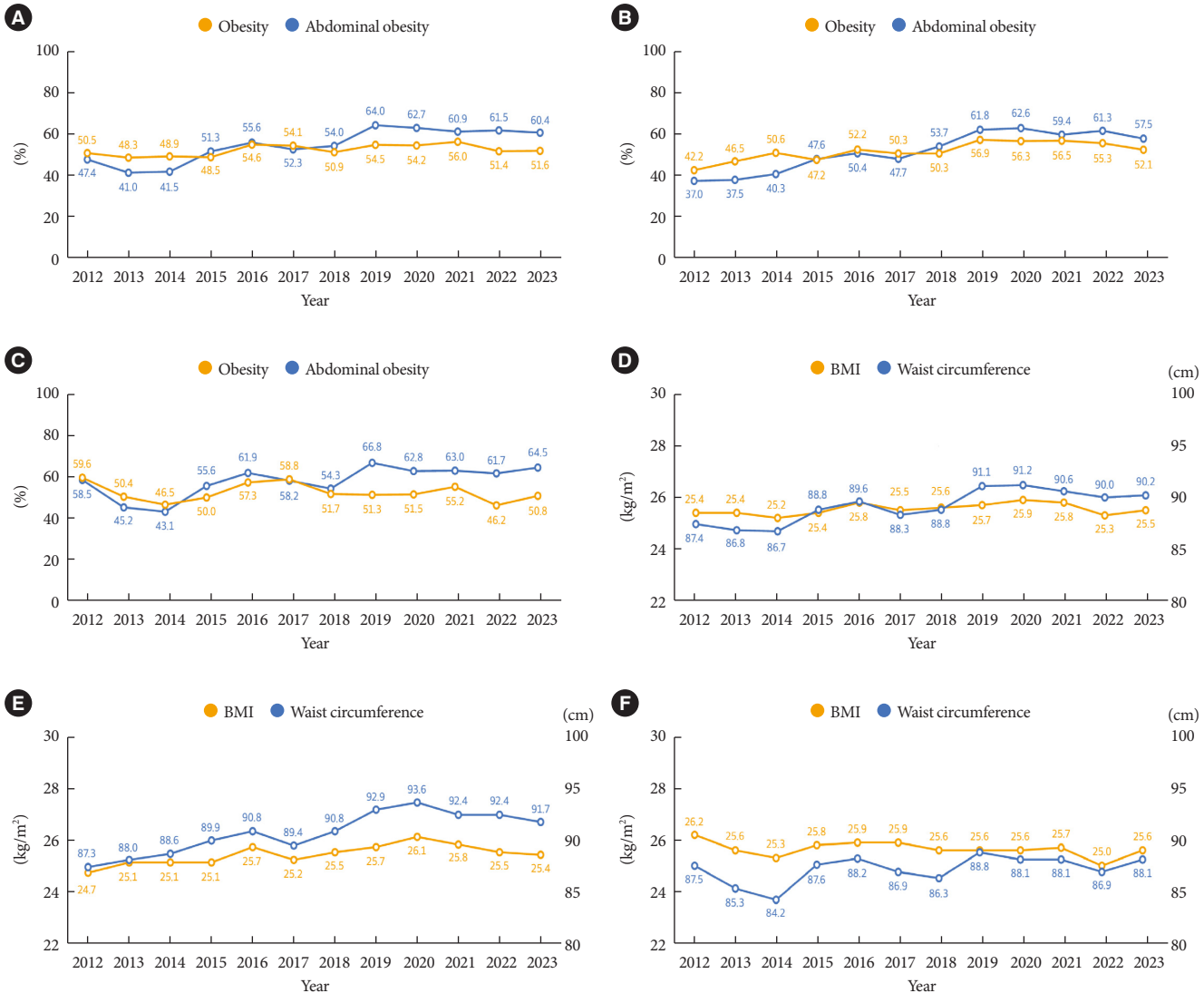


Fig. 2. Trends in the prevalence of overall and abdominal obesity—(A) total, (B) men, (C) women—and changes in mean body mass index (BMI) and waist circumference—(D) total, (E) men, (F) women—among adults with diabetes, Korea National Health and Nutrition Examination Survey 2012–2023.

the decade, from 71.9 in 2013 to 75.1 cm in 2023. In contrast, women with PGDM had substantially larger pre-pregnancy waist measurements, increasing from 77.9 cm in 2013 to 82.9 cm in 2023. In addition, the mean FPG before pregnancy increased modestly in the overall population, from 87.6 mg/dL in 2013 to 91.4 mg/dL in 2023 (Fig. 4D). Women with GDM had slightly higher FPG levels, rising from 90.2 to 94.4 mg/dL over the same period. In contrast, women with PGDM showed markedly higher baseline glucose levels, which further increased from 118.1 mg/dL in 2013 to 123.2 mg/dL in 2023.

Risk of incident T2DM after delivery

During follow-up, T2DM developed in 98,650 (3.4%) women without diabetes in pregnancy and in 17,485 (16.4%) women with GDM (Table 2). The incidence rate of T2DM was substantially higher in women with GDM than in those without diabetes in pregnancy, at 12.7 versus 2.1 per 1,000 person-years. Compared with women without diabetes in pregnancy, those with a history of GDM had a markedly higher risk of developing T2DM (age adjusted hazard ratio [aHR], 6.07; 95% CI, 5.97 to 6.17). When stratified by maternal age, the incidence rate of T2DM among women with GDM was highest in those aged

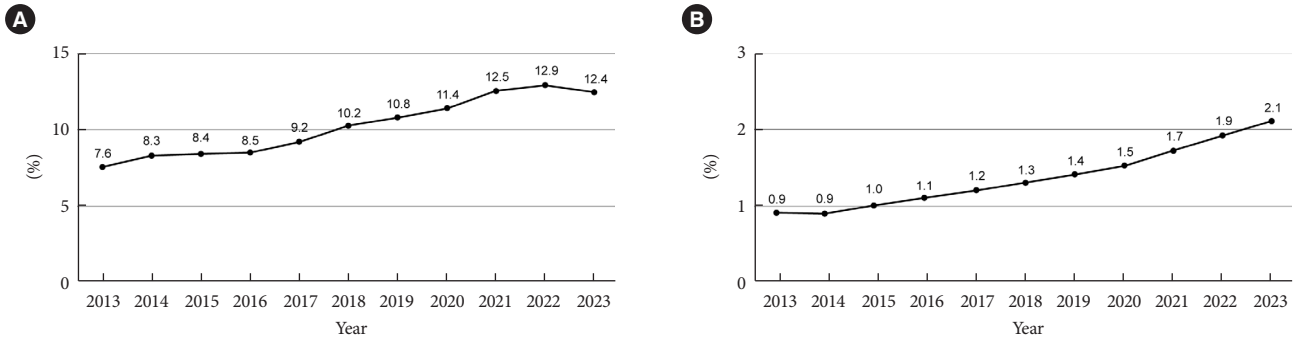


Fig. 3. Trends in the prevalence of (A) gestational diabetes mellitus and (B) pregestational diabetes mellitus between 2013 and 2023, based on data from National Health Insurance Service.

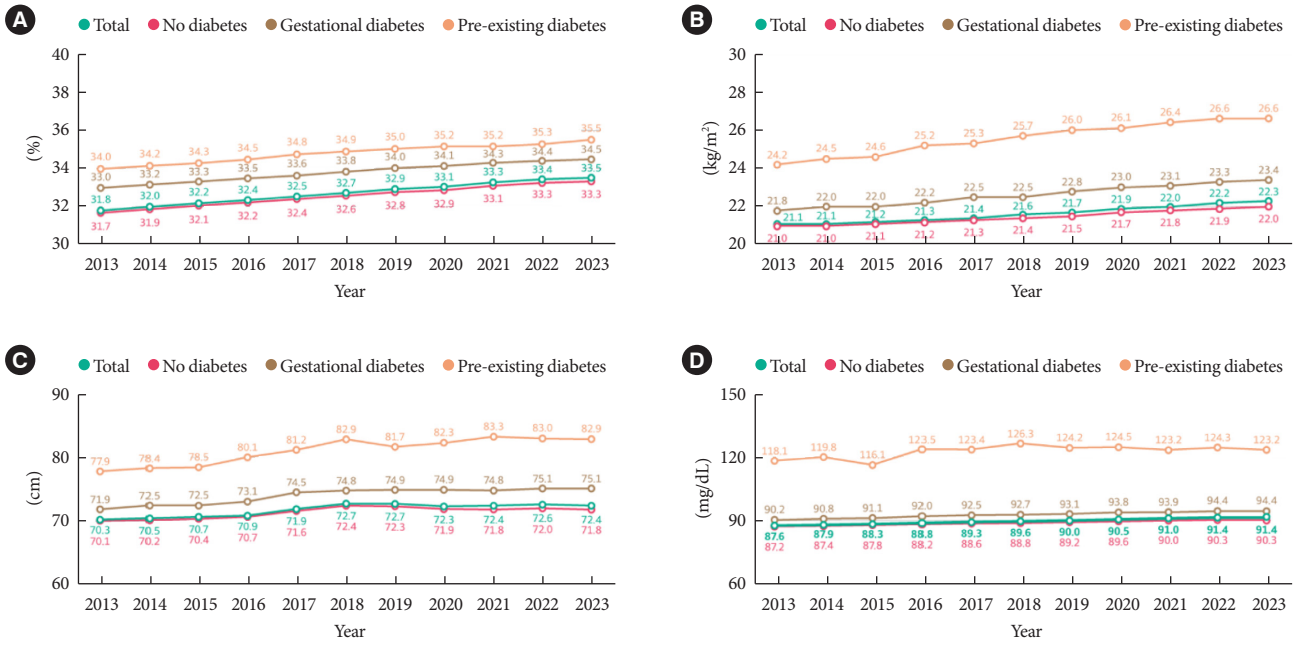


Fig. 4. Recent trends in pre-pregnancy clinical and metabolic profiles among women who gave birth in Korea, 2013–2023, on data from National Health Insurance Service. (A) Mean maternal age at delivery. (B) Pre-pregnancy body mass index. (C) Pre-pregnancy waist circumference. (D) Pre-pregnancy fasting plasma glucose.

≥40 years, followed by those in their 30s and 20s (19.5, 13.3, and 10.1 per 1,000 person-years, respectively). In subgroup analyses according to insulin use during the GDM period, the incidence rate of T2DM was higher among women who required insulin therapy than among those who did not (53.0 vs. 9.7 per 1,000 person-years, respectively). When compared with women without diabetes in pregnancy, the aHR for developing T2DM was 4.70 (95% CI, 4.61 to 4.79) among women with GDM not treated with insulin and 26.07 (95% CI, 25.33 to 26.82) among those who received insulin during the GDM period.

DISCUSSION

The prevalence of obesity among Korean adults aged ≥19 years with diabetes is 52.4%, affecting an estimated 2.67 million individuals in 2022 to 2023. Among adults with diabetes, the prevalence of obesity was higher in younger age groups. Over the past 12 years, the prevalence of abdominal obesity has increased, particularly relative to general obesity. However, only 39.9% of adults with diabetes mellitus achieved the glycemic target. These national trends in obesity and metabolic dysfunction are mirrored in pregnancy, where diabetes in pregnancy

Table 2. Incidence and risk of type 2 diabetes mellitus according to diabetes status during pregnancy

	Event	Duration, person-yr	Incident rate, 1,000 person-yr	Age-adjusted HR (95% CI)
T2DM				
No DIP	98,650	46,396,719.9	2.1	1 (Ref.)
GDM total	17,485	1,375,560.9	12.7	6.07 (5.97–6.17)
By insulin treatment				
GDM with insulin	5,120	96,692.4	53.0	26.07 (25.33–26.82)
GDM without insulin	12,365	1,278,868.5	9.7	4.70 (4.61–4.79)
By age group				
GDM (20–29 yr)	3,817	378,910.7	10.1	-
GDM (30–39 yr)	12,331	928,067.7	13.3	-
GDM (≥40 yr)	1,337	68,582.5	19.5	-

HR, hazard ratio; CI, confidence interval; T2DM, type 2 diabetes mellitus; DIP, diabetes in pregnancy; GDM, gestational diabetes mellitus.

has emerged as an increasingly common complication. In this nationwide cohort, the number of annual deliveries in Korea declined by roughly half between 2013 and 2023, yet the proportion of pregnancies accompanied by diabetes rose. The prevalence of GDM increased from 7.6% to 12.4%, driven by a relatively modest reduction in the absolute number of GDM cases compared with the decline in total births. The PGDM also increased, both in absolute count and as a share of all deliveries, from 0.9% to 2.1%. Over the same period, the maternal age, pre-pregnancy BMI, WC, and FPG rose at the population level, with consistently higher values in GDM and the highest values in PGDM. Postpartum, women with prior GDM experienced a substantially higher incidence of T2DM than those without diabetes in pregnancy (12.7 vs. 2.1 per 1,000 person-years), corresponding to an age-aHR of 6.07 (95% CI, 5.97 to 6.17).

In this nationally representative analysis, obesity affected over half of Korean adults with diabetes, with abdominal obesity even more common. The prevalence peaked in the 30s–40s age group and declined thereafter, indicating a substantial burden among younger adults with T2DM. These findings suggest that a substantial subset of T2DM in Korea arises in the context of obesity during the most economically and socially active decades of life, consistent with evidence that excess adiposity accelerates β-cell failure and precipitates earlier diabetes onset [26,27]. Earlier onset prolongs lifetime exposure to hyperglycemia and thereby increases the risk of long-term complications [28]. The high prevalence of obesity underscores the need to prioritize weight management in the prevention and treatment of T2DM in young adults. Recent clinical practice guidelines also emphasize a weight-centric approach in the management of people with T2DM and obesity [6,29]. Although prescriptions of antidiabetic agents with weight-reducing benefits have increased, the proportion of young adults with diabetes receiving glucagon like peptide-1 receptor agonists remains low in Korea [30]. From a clinical and public health perspective, the concentration of obesity and abdominal obesity with diabetes highlights the need to shift prevention and management strategies 'upstream' to earlier life stages. Weight control should be considered in the management of people with T2DM and obesity, with clinicians not only accounting for the weight effects of prescribed therapies but also monitoring central adiposity (e.g., WC) and actively supporting patients in implementing targeted lifestyle modifications.

Temporal patterns underscore a divergence between general and abdominal adiposity. Over the most recent 12 years, the general obesity prevalence remained relatively stable, whereas abdominal obesity rose, paralleled by a stable BMI but an increasing WC. Among men, the prevalence of both general and abdominal obesity rose, whereas among women, the prevalence of general obesity tended toward decline, while that of abdominal obesity increased. This points to a redistribution of fat toward visceral depots rather than uniform weight gain. Mechanistically, our finding of stable BMI but rising abdominal obesity suggests a shift toward visceral and ectopic fat deposition, which is tightly linked to insulin resistance, atherogenic dyslipidemia, metabolic dysfunction-associated steatotic liver disease,

and cardiorenal complications [31]. This redistribution phenotype over the past decade may partly reflect secular trends in physical inactivity, sleep dysregulation, ultra-processed food consumption, and broader lifestyle changes [32]. Sex-specific patterns—more pronounced increases in both general and visceral adiposity in men and rising visceral adiposity despite stable BMI in women—raise the possibility of interactions with the androgen–estrogen milieu, menopausal transition in women, lifestyle differences by sex, and differential changes in body composition, which warrant targeted investigation [24,33].

These population-level shifts in adiposity and metabolic dysfunction are increasingly reflected among women of reproductive age. The rising prevalence of obesity, central fat accumulation, and insulin resistance in younger adults likely contributes to worsening metabolic health entering pregnancy [34]. In this context, diabetes in pregnancy has emerged as an important marker of intergenerational metabolic risk in Korea. The divergence between declining births and rising diabetes in pregnancy prevalence indicates a growing metabolic burden per pregnancy. The stepwise gradient in age and metabolic indices (no diabetes in pregnancy < GDM < PGDM) aligns with a continuum of dysglycemia that often predates conception and becomes unmasked or exacerbated during gestation [35]. The concurrent increase in BMI and the more pronounced rise in WC suggest a shift toward abdominal obesity that may further impair glucose regulation before and during pregnancy. The persistently higher FPG levels observed in GDM and even more so in PGDM support the presence of antecedent glycemic vulnerability at conception.

These findings underscore three windows for intervention: preconception, during pregnancy, and postpartum. Preconception risk assessment and weight management may reduce both incident GDM and unrecognized PGDM [36,37]. During pregnancy, stratifying care according to the baseline metabolic profile (age, BMI, WC, and FPG) may help tailor surveillance and glycemic management [38]. Postpartum, the six-fold elevation in T2DM risk after GDM highlights the need for systematic glucose testing, timely transition to primary or endocrine care, and durable weight-centered strategies [39,40]. In addition, the stronger association observed for central adiposity suggests that WC may serve as a complementary monitoring target alongside body weight. Waist-focused counseling does not imply a separate clinical strategy but rather emphasizes prioritizing interventions that preferentially target visceral fat (e.g., physical activity and dietary modification), thereby refining risk stratification and informing intervention focus, particularly in reproductive-age women.

Given that this was a population-based cohort study, these trends likely reflect system-level needs, including a standardized preconception screening pathway, integration of pregnancy records with primary care to trigger postpartum testing, and accessible lifestyle and pharmacologic weight management options after delivery, particularly for women with prior GDM [41]. Monitoring diabetes in pregnancy as an indicator within maternal health programs may aid resource allocation as births decline but the metabolic risk per pregnancy rises. In addition, future research should prospectively evaluate integrated weight-centric care pathways spanning preconception to postpartum, including OGTT-based risk stratification and structured follow-up, and quantify their effects on postpartum testing uptake, incident T2DM, and long-term cardiometabolic outcomes.

This study had some limitations. First, KNHANES provides repeated cross-sectional data; so, we could not infer causality or follow individual trajectories over time. Second, both KNHANES and NHIS data are subject to potential misclassification of diabetes (including GDM and PGDM), obesity, and comorbidities, and may not fully capture behavioral or treatment-related factors. Third, recent trends in diabetes in pregnancy may have been influenced by changes in screening practices and diagnostic criteria for which we could not completely adjust. In addition, variables such as gestational weight gain, parity, and dietary habits were not available, limiting our ability to assess their potential influence on diabetes in pregnancy and long-term outcomes. Additionally, our prevalence estimates for diabetes in pregnancy were delivery-based and thus reflect the per-delivery burden at the population level, rather than woman-based risk. Delivery-based metrics may be influenced by changes in fertility structure over time (e.g., maternal age and parity) and recurrent GDM across pregnancies; therefore, they should be interpreted as per-pregnancy burden rather than individual-level probability.

In conclusion, this nationwide analysis delineates parallel trends of obesity in diabetes and diabetes in pregnancy within Korea, revealing a growing metabolic burden across the life course. More than half of adults with diabetes are obese, most prominently in younger age groups, while abdominal obesity continues to rise despite stable BMI. Concurrently, the prevalence of diabetes in pregnancy has approximately doubled over the past decade, reflecting worsening preconception metabolic

health and translating into a six-fold higher postpartum diabetes risk. These findings emphasize the need for integrated weight-centric strategies spanning preconception, pregnancy, and postpartum care to mitigate the intergenerational transmission of metabolic risk and curb the future burden of T2DM and related complications.

SUPPLEMENTARY MATERIALS

Supplementary materials related to this article can be found online at https://doi.org/10.4093/dmj.2025.1162.

CONFLICTS OF INTEREST

Seung-Hyun Ko has been an executive editor of the *Diabetes & Metabolism Journal* since 2022. Seung-Hwan Lee has been an associate editor of the *Diabetes & Metabolism Journal* since 2022. Sung Hee Choi has been an associate editor of the *Diabetes & Metabolism Journal* since 2022. They were not involved in the review process of this article. Otherwise, there was no conflict of interest.

AUTHOR CONTRIBUTIONS

Conception or design: S.E.P., S.H.M., S.H.L., S.H.K., B.S.C., S.H.C.
Acquisition, analysis, or interpretation of data: S.E.P., S.H.M., J.H.K, S.H.L., H.N.J., J.H.M., K.H., S.H.C.
Drafting the work or revising: S.E.P., S.H.M., H.N.J., J.H.M., B.S.C., S.H.C.
Final approval of the manuscript: all authors.

ORCID

Se Eun Park *https://orcid.org/0000-0002-3809-2268*
Se Hee Min *https://orcid.org/0000-0001-9423-3937*
Bong Soo Cha *https://orcid.org/0000-0003-0542-2854*
Sung Hee Choi *https://orcid.org/0000-0003-0740-8116*

FUNDING

This research was supported by National Research Foundation (NRF) of Korea (2024-00393728) and the Korean Diabetes Association.

ACKNOWLEDGMENTS

None

REFERENCES

1. GBD 2021 Diabetes Collaborators. Global, regional, and national burden of diabetes from 1990 to 2021, with projections of prevalence to 2050: a systematic analysis for the Global Burden of Disease Study 2021. Lancet 2023;402:203-34.
2. Wu H, Ballantyne CM. Metabolic inflammation and insulin resistance in obesity. Circ Res 2020;126:1549-64.
3. Lim S, Nam GE, Sharma AM. Differences between type 2 diabetes mellitus and obesity management: medical, social, and public health perspectives. Diabetes Metab J 2025;49:565-79.
4. Park SE, Ko SH, Kim JY, Kim K, Moon JH, Kim NH, et al. Diabetes fact sheets in Korea 2024. Diabetes Metab J 2025;49:524.
5. Lingvay I, Sumithran P, Cohen RV, le Roux CW. Obesity management as a primary treatment goal for type 2 diabetes: time to reframe the conversation. Lancet 2022;399:394-405.
6. Kang S, Kang SM, Choi JH, Ko SH, Koo BK, Kwon HS, et al. 2025 Clinical practice guidelines for diabetes management in Korea: recommendation of the Korean Diabetes Association. Diabetes Metab J 2025;49:582-783.
7. Eades CE, Burrows KA, Andreeva R, Stansfield DR, Evans JM. Prevalence of gestational diabetes in the United States and Canada: a systematic review and meta-analysis. BMC Pregnancy Childbirth 2024;24:204.
8. Gregory EC, Ely DM. Trends and characteristics in prepregnancy diabetes: United States, 2016-2021. Natl Vital Stat Rep 2023;72:1-13.
9. Hivert MF, Backman H, Benhalima K, Catalano P, Desoye G, Immanuel J, et al. Pathophysiology from preconception, during pregnancy, and beyond. Lancet 2024;404:158-74.
10. Tagami K, Iwama N, Hamada H, Tomita H, Kudo R, Kumagai N, et al. Advanced maternal age is a risk factor for both early and late gestational diabetes mellitus: the Japan Environment and Children's Study. J Diabetes Investig 2025;16:735-43.
11. Kiljan M, Szablewska AW. Prenatal physical activity, pre-pregnancy BMI, and their relationship with gestational diabetes: a retrospective-prospective single-center study. Nutrients 2025;17:786.
12. Zhu Y, Hedderson MM, Quesenberry CP, Feng J, Ferrara A. Central obesity increases the risk of gestational diabetes partially through increasing insulin resistance. Obesity (Silver

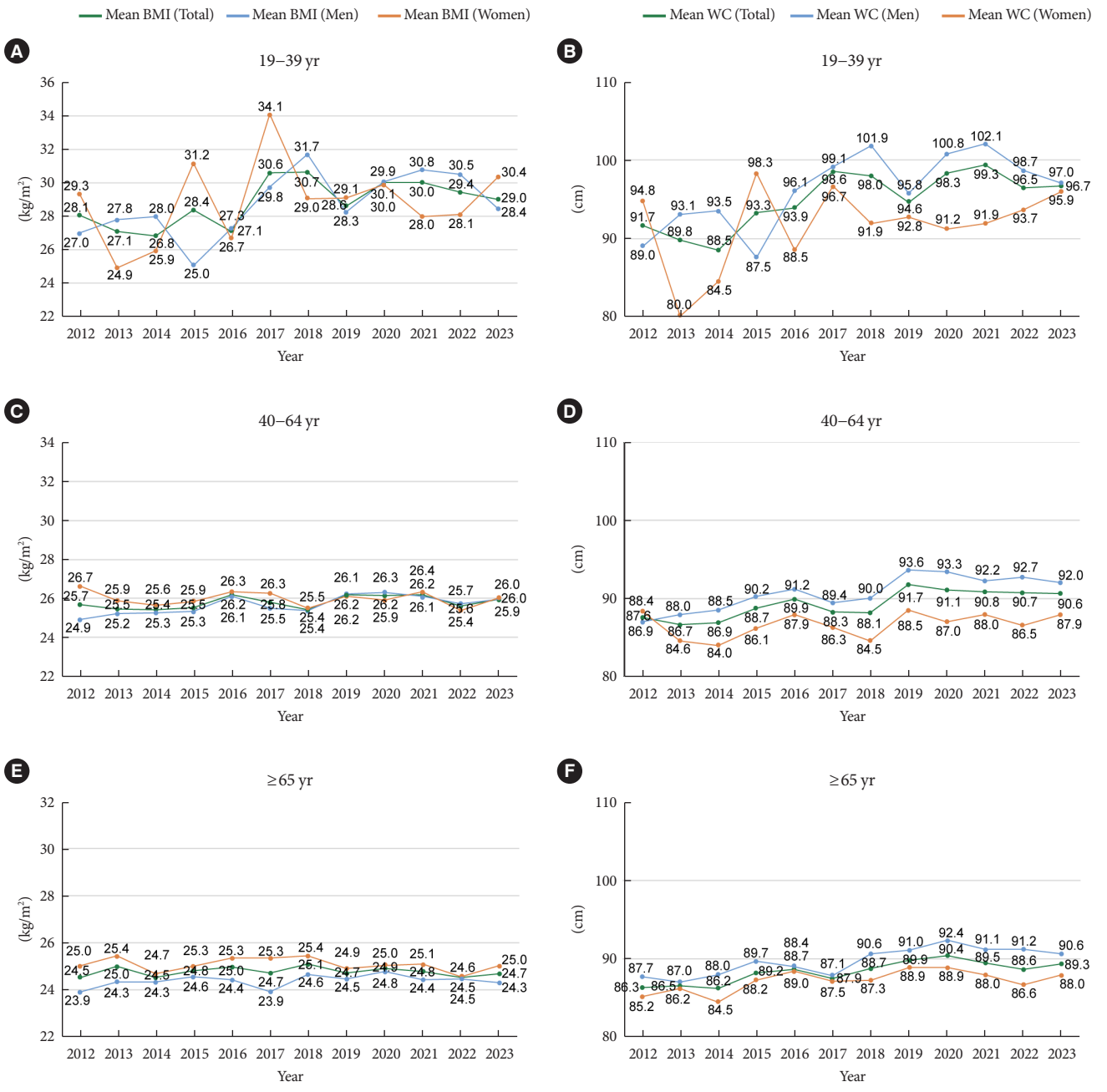
Spring) 2019;27:152-60.
13. Goldet G, Dattani R, Pierce B, Ul-Haq Z, Kamalati T, Shah M, et al. Health outcomes of women with gestational diabetes mellitus in North West London: a 10-year longitudinal study. BMJ Public Health 2025;3:e002279.
14. Chen A, Tan B, Du R, Chong YS, Zhang C, Koh AS, et al. Gestational diabetes mellitus and development of intergenerational overall and subtypes of cardiovascular diseases: a systematic review and meta-analysis. Cardiovasc Diabetol 2024;23:320.
15. Dieguez AC, Kuang A, Josefson JL, Scholtens DM, Lowe WL, Hayes MG, et al. In utero exposure to maternal hyperglycemia and offspring type 2 diabetes genetic risk score are independently associated with risk of impaired glucose tolerance in youth. Diabetes Care 2025;48:1356-60.
16. Wicklow B, Retnakaran R. Gestational diabetes mellitus and Its Implications across the life span. Diabetes Metab J 2023;47: 333-44.
17. Deng Y, Wu H, Ng NY, Tam CH, Tsang AY, Chan MH, et al. Association between maternal glucose levels in pregnancy and offspring's metabolism and adiposity: an 18-year birth cohort study. Diabetologia 2025;68:2205-16.
18. Li W, Wang L, Liu H, Zhang S, Li W, Leng J, et al. Maternal gestational diabetes and childhood adiposity risk from 6 to 8 years of age. Int J Obes (Lond) 2024;48:414-22.
19. Chung HR, Moon JH, Lim JS, Lee YA, Shin CH, Hong JS, et al. Maternal hyperglycemia during pregnancy increases adiposity of offspring. Diabetes Metab J 2021;45:730-8.
20. Vounzoulaki E, Khunti K, Abner SC, Tan BK, Davies MJ, Gillies CL. Progression to type 2 diabetes in women with a known history of gestational diabetes: systematic review and meta-analysis. BMJ 2020;369:m1361.
21. Clement NS, Abul A, Farrelly R, Murphy HR, Forbes K, Simpson NA, et al. Pregnancy outcomes in type 2 diabetes: a systematic review and meta-analysis. Am J Obstet Gynecol 2025; 232:354-66.
22. Korean Diabetes Association. Korean diabetes fact sheet. Available from: https://www.diabetes.or.kr/bbs/?code=eng_fact_sheet (cited 2026 Jan 21).
23. Oh K, Kim Y, Kweon S, Kim S, Yun S, Park S, et al. Korea National Health and Nutrition Examination Survey, 20th anniversary: accomplishments and future directions. Epidemiol Health 2021;43:e2021025.
24. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care 2014;37 Suppl 1:S81-90.
25. Kim BY, Kang SM, Kang JH, Kang SY, Kim KK, Kim KB, et al. 2020 Korean Society for the Study of Obesity guidelines for the management of obesity in Korea. J Obes Metab Syndr 2021;30: 81-92.
26. GBD 2021 Adult BMI Collaborators. Global, regional, and national prevalence of adult overweight and obesity, 1990-2021, with forecasts to 2050: a forecasting study for the Global Burden of Disease Study 2021. Lancet 2025;405:813-38.
27. Rubino F, Cummings DE, Eckel RH, Cohen RV, Wilding JP, Brown WA, et al. Definition and diagnostic criteria of clinical obesity. Lancet Diabetes Endocrinol 2025;13:221-62.
28. Lascar N, Brown J, Pattison H, Barnett AH, Bailey CJ, Bellary S. Type 2 diabetes in adolescents and young adults. Lancet Diabetes Endocrinol 2018;6:69-80.
29. American Diabetes Association Professional Practice Committee. 8. Obesity and weight management for the prevention and treatment of type 2 diabetes: standards of care in diabetes-2025. Diabetes Care 2025;48(1 Suppl 1):S167-80.
30. Kim JY, Lee J, Moon JH, Park SE, Ko SH, Choi SH, et al. Prevalence, incidence, and metabolic characteristics of young adults with type 2 diabetes mellitus in South Korea (2010-2020). Diabetes Metab J 2025;49:172-82.
31. Cesaro A, De Michele G, Fimiani F, Acerbo V, Scherillo G, Signore G, et al. Visceral adipose tissue and residual cardiovascular risk: a pathological link and new therapeutic options. Front Cardiovasc Med 2023;10:1187735.
32. Han Y, Sung H, Choi Y, Kim YS. Trends in obesity, leisure-time physical activity, and sedentary behavior in Korean adults: Korea national health and nutritional examinations survey from 2014 to 2021. PLoS One 2024;19:e0296042.
33. Kodoth V, Scaccia S, Aggarwal B. Adverse changes in body composition during the menopausal transition and relation to cardiovascular risk: a contemporary review. Womens Health Rep (New Rochelle) 2022;3:573-81.
34. Catalano PM, Shankar K. Obesity and pregnancy: mechanisms of short term and long term adverse consequences for mother and child. BMJ 2017;356:j1.
35. Plows JF, Stanley JL, Baker PN, Reynolds CM, Vickers MH. The pathophysiology of gestational diabetes mellitus. Int J Mol Sci 2018;19:3342.
36. Martinez-Hortelano JA, Cavero-Redondo I, Alvarez-Bueno C, Diez-Fernandez A, Hernandez-Luengo M, Martinez-Vizcaino V. Interpregnancy weight change and gestational diabetes mellitus: a systematic review and meta-analysis. Obesity (Silver Spring) 2021;29:454-64.
37. Torkel S, Mantzioris E, Villani A, Kellow NJ, Bhatnagar D, Os-

ei-Safo EK, et al. Preconception lifestyle interventions for women-a systematic review and meta-analysis of intervention characteristics and behaviour change techniques. Hum Reprod Update 2026;32:105-27.
38. Oteng-Ntim E, Varma R, Croker H, Poston L, Doyle P. Lifestyle interventions for overweight and obese pregnant women to improve pregnancy outcome: systematic review and meta-analysis. BMC Med 2012;10:47.
39. Ratner RE, Christophi CA, Metzger BE, Dabelea D, Bennett PH, Pi-Sunyer X, et al. Prevention of diabetes in women with a history of gestational diabetes: effects of metformin and lifestyle interventions. J Clin Endocrinol Metab 2008;93:4774-9.
40. Wang Y, Wei W, Guo H, Wang D, Wei X, Zhang C, et al. Postpartum life interventions to prevent type 2 diabetes in women with gestational diabetes: a systematic review and meta-analysis. J Diabetes Investig 2024;15:1115-28.
41. Vesco KK, Dietz PM, Bulkley J, Bruce FC, Callaghan WM, England L, et al. A system-based intervention to improve postpartum diabetes screening among women with gestational diabetes. Am J Obstet Gynecol 2012;207:283.e1-6.

Supplementary Table 1. Distribution of obesity and abdominal obesity among adults aged ≥19 years with diabetes: KNHANES 2022–2023

	Total	Men	Women
Underweight (BMI <18.5 kg/m^2)	2.1±0.5 (107,862)	2.1±0.7 (63,546)	2.1±0.6 (44,315)
Normal (BMI 18.5–22.9 kg/m^2)	23.5±1.3 (1,194,505)	21.8±1.6 (651,290)	25.9±1.9 (543,215)
Pre-obesity (BMI 23.0–24.9 kg/m^2)	22.0±1.2 (1,116,433)	21.1±1.5 (629,886)	23.2±1.9 (486,548)
Class I obesity (BMI 25.0–29.9 kg/m^2)	40.0±1.4 (2,036,547)	42.0±2.0 (1,254,882)	37.3±2.1 (781,664)
Class II obesity (BMI 30.0–34.9 kg/m^2)	10.1±0.9 (515,076)	10.7±1.4 (319,816)	9.3±1.3 (195,260)
Class III obesity (BMI ≥35.0 kg/m^2)	2.3±0.5 (115,384)	2.3±0.8 (69,932)	2.2±0.6 (45,453)

Values are presented as percentages with mean±standard error (number).
KNHANES, Korea National Health and Nutrition Examination Survey; BMI, body mass index.



Supplementary Fig. 1. Trends in body mass index (BMI) and waist circumference (WC) by age group, 2012–2023. Mean BMI (A, C, E) and waist circumference (B, D, F) are shown for adults aged 19–39, 40–64, and ≥65 years, respectively.