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Postprint: Prevalence and Epidemiological Study of Gestational Diabetes Mellitus in Hebei Province, 2014–2021

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Abstract

Background Gestational diabetes mellitus (GDM) is one of the common pregnancy complications. GDM not only increases the risk of maternal short-term and long-term complications such as preeclampsia and type 2 diabetes mellitus, but also increases the incidence of fetal malformation, macrosomia, and other risks. It has become a public health and social issue that cannot be ignored.

Objective To investigate the prevalence and epidemiological characteristics of gestational diabetes mellitus among parturients in Hebei Province.

Methods A cross-sectional study was conducted using inpatient delivery information from the Maternal Surveillance Information System (22 monitoring hospitals) provided by the Hebei Maternal and Child Health Center from 2014 to 2021. The data collected included delivery hospital, age, marital status, educational level, gravidity, parity, number of prenatal visits, delivery season, pregnancy complications in the current pregnancy, delivery mode, neonatal gender, birth weight, and NICU admission, among others.

Results A total of 366,212 parturients were enrolled in this study, of whom 25,995 were diagnosed with GDM, yielding a prevalence rate of 7.1%. From 2014 to 2021, the prevalence of GDM among parturients in Hebei Province showed an increasing trend year by year (^{2} trend = 6,921.4, P<0.001); the prevalence of GDM among advanced maternal age mothers showed an increasing trend year by year (^{2} trend = 779.0, P<0.001); the prevalence of GDM among urban mothers showed an increasing trend year by year (^{2} trend = 5,057.1, P<0.001). Comparison of GDM prevalence across different regions in Hebei Province showed statistically significant differences (^{2} = 16,919.785, P<0.001). From 2014 to 2021, the prevalence of GDM among urban mothers in Hebei Province was 10.6% (19,200/180,369), which was

higher than that among rural mothers at 3.7% (6,795/185,843) (^{2} = 6,779.019, P<0.001). From 2014 to 2021, the prevalence of GDM among mothers delivering in primary-level hospitals in Hebei Province was 0.7% (34/4,731), in secondary-level hospitals was 3.7% (6,733/180,923), and in tertiary-level hospitals was 10.6% (19,228/180,558). Comparison of GDM prevalence across different hospital levels showed statistically significant differences (^{2} = 6,872.8, P<0.001). Comparisons of GDM prevalence among groups with different ages, educational levels, number of pregnancies, parity, and number of prenatal visits all showed statistically significant differences (P<0.05); among which, the GDM prevalence among mothers aged 18-35, 35-40, and $ $40 years was higher than that among mothers aged <18 years (P<0.05), and the GDM prevalence among mothers aged 35-40 and $ $40 years was higher than that among mothers aged 18-35 years (P<0.05); the GDM prevalence among mothers with university degree or above was higher than that among mothers with high school and junior high school education, and primary school or below (P<0.05); mothers with more pregnancies had higher GDM prevalence than those with one pregnancy; the GDM prevalence among multiparous women was higher than that among primiparous women (P<0.05); mothers with $ 8 prenatal visits had higher GDM prevalence than those with < 8 prenatal visits ($P < 0.05$). From 2014 to 2021, the prevalence of GDM among mothers in Hebei Province was 7.27^ = 9.35, P<0.05). Comparisons of GDM prevalence among mothers with different hypertensive disorders of pregnancy, anemia, uterine atony, delivery modes, and macrosomia all showed statistically significant differences (P<0.05).

Conclusion The prevalence of GDM among parturients in Hebei Province from 2014 to 2021 was 7.1%, with an increasing trend year by year. The prevalence of GDM was increased among parturients of advanced maternal age, urban residence, high educational level, multiple pregnancies, and multiparity. GDM has a significant impact on pregnancy outcomes, necessitating continued emphasis on early screening, standardized management, and treatment of high-risk populations.

Full Text

Prevalence and Epidemiology of Gestational Diabetes Mellitus from 2014 to 2021 in Hebei Province

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Abstract

Background: Gestational diabetes mellitus (GDM) is one of the common pregnancy complications, which not only increases maternal risk of short-term and long-term complications such as preeclampsia and type 2 diabetes, but also elevates incidence rates of fetal malformation and macrosomia. GDM has become a public health and social issue that cannot be ignored.

Objective: To investigate the prevalence and epidemiological characteristics of GDM in Hebei Province.

Methods: Using a cross-sectional study design, we collected inpatient delivery data from the Maternal Monitoring Information System (22 monitoring hospitals) provided by the Hebei Center for Maternal and Child Health from 2014 to 2021. Data included maternal delivery hospital, age, marital status, education level, number of pregnancies, parity, number of prenatal examinations, delivery season, pregnancy complications, delivery mode, newborn gender, birth weight, and NICU admission.

Results: A total of 366,212 pregnant women were enrolled, among whom 25,995 were diagnosed with GDM, yielding a prevalence of 7.1%. The prevalence of GDM among pregnant women in Hebei Province showed a year-by-year increasing trend from 2014 to 2021 (^{2} trend = 6,921.4, P<0.001). The prevalence among advanced maternal age women also showed a year-by-year increasing trend (^{2} trend = 779.0, P<0.001), as did urban women (^{2} trend = 5,057.1, P<0.001). There were statistically significant differences in GDM prevalence across different regions of Hebei Province (^{2} = 16,919.785, P<0.001). From 2014 to 2021, the prevalence among urban women was 10.6% (19,200/180,369), significantly higher than the 3.7% (6,795/185,843) among rural women (^{2} = 6,779.019, P<0.001). The prevalence was 0.7% (34/4,731) in primary hospitals, 3.7% (6,733/180,923) in secondary hospitals, and 10.6% (19,228/180,558) in tertiary hospitals, with statistically significant differences among hospital levels (^{2} = 6,872.8, P<0.001). Statistically significant differences were observed in GDM prevalence across different age groups, education levels, pregnancy numbers, parity, and prenatal examination frequencies (P<0.05). Specifically, women aged 18-35, 35-40, and $ $40 years had higher prevalence than those <18 years (P<0.05), and women aged 35-40 and $ $40 years had higher prevalence than those aged 18-35 years (P<0.05). Women with university education or higher had higher prevalence than those with high school/junior high school or primary school/illiteracy (P<0.05). Women with multiple pregnancies had higher prevalence than those with one pregnancy. Multiparous women had higher prevalence than primiparous women (P<0.05). Women with $ 8*prenatalexaminationshadhigherprevalencethanthosewith* <

$8examinations(P < 0.05).Seasonaldifferenceswereobserved : spring(March-May)7.27\hat{}\{2\}\$ = 9.35$, P<0.05). Significant differences were also found in GDM prevalence among women with gestational hypertension, anemia, uterine atony, different delivery modes, and macrosomia (P<0.05).

Conclusion: The prevalence of GDM among pregnant women in Hebei Province was 7.1% from 2014 to 2021, showing a year-by-year increasing trend. The prevalence increased among women of advanced age, urban residence, high education level, multiple pregnancies, and multiparous women. GDM has significant impacts on pregnancy outcomes, requiring continuous attention to early screening, standardized management, and treatment of high-risk populations.

Keywords: Diabetes, gestational; Hebei Province; Prevalence; Epidemiology; Public health

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Introduction

Gestational diabetes mellitus (GDM) is defined as diabetes that occurs during pregnancy in women with normal pre-pregnancy glucose metabolism and is a common pregnancy complication. GDM prevalence varies widely worldwide. In recent years, GDM prevalence has shown an upward trend. GDM not only increases maternal risks of preeclampsia and hyperlipidemia but also elevates risks of fetal malformation and macrosomia, while increasing future risks of type 2 diabetes, postpartum weight retention, and metabolic diseases in offspring [1-2]. This study analyzed cross-sectional survey data from 22 monitoring hospitals in Hebei Province from 2014 to 2021 to examine GDM conditions across different time periods, regions, and clinical characteristics, aiming to enable early prevention, intervention, and standardized treatment of GDM to reduce adverse pregnancy outcomes.

Methods

1.1 General Data We collected inpatient delivery information from 2014 to 2021 from the Maternal Monitoring Information System (22 monitoring hospitals) provided by the Hebei Center for Maternal and Child Health. Data included maternal age, delivery hospital, pregnancy complications, delivery mode, newborn birth weight, and other information. Inclusion criteria: data from women delivering singleton live births at $ $28 weeks gestation. Exclusion criteria included stillbirths, multiple pregnancies, and incomplete data. This study included 366,212 cases, among which 25,995 were diagnosed with GDM. The study was approved by the Hebei Center for Maternal and Child Health Ethics Committee (approval number 2012008).

1.2 Methods We excluded cases with gestational age <28 weeks, twin pregnancies, stillbirths, pre-pregnancy diabetes, missing data, and undelivered cases.

GDM diagnostic criteria: Women underwent a 75g oral glucose tolerance test (at 24-28 weeks gestation). Diagnosis was made if any of the following values were abnormal: fasting blood glucose (<5.1 mmol/L), 1-hour post-glucose blood glucose (<10.0 mmol/L), or 2-hour venous blood glucose (<8.5 mmol/L) [3]. Advanced maternal age was defined as women giving birth at age >35 years. In China, hospital qualifications are evaluated based on hospital scale, research direction, technical expertise, and medical equipment, with hospitals classified as primary, secondary, or tertiary after review. Urban areas were defined as cities at the municipal level and above, while rural areas were defined as counties and below. Gestational hypertension was diagnosed according to the Guidelines for Diagnosis and Treatment of Hypertensive Disorders in Pregnancy [4]. Anemia was defined as hemoglobin <110 g/L in pregnant women [5]. Uterine atony was defined as contraction pressure <180 units and frequency <2 times/10 minutes during labor [6]. Macrosomia was defined as birth weight $ $4,000 g [6].

1.3 Statistical Analysis We used SPSS 22.0 software for statistical analysis. Categorical data were expressed as relative frequencies, and inter-group comparisons were performed using ^{2} tests or trend ^{2} tests. P<0.05 was considered statistically significant.

Results

2.1 Trend Analysis of GDM Prevalence from 2014 to 2021 Among 366,212 cases, 25,995 were diagnosed with GDM, yielding a prevalence of 7.1%. The annual prevalence of GDM showed a year-by-year increasing trend from 2014 to 2021 (^{2} trend = 6,921.4, P<0.001) [Figure 1: see original paper]. Both advanced maternal age women (^{2} trend = 779.0, P<0.001) and urban women (^{2} trend = 5,057.1, P<0.001) showed year-by-year increasing trends in GDM prevalence [Figure 2: see original paper].

2.2.1 Regional Distribution From 2014 to 2021, GDM prevalence varied significantly across regions: Chengde City 2.8% (278/9,788), Zhangjiakou City 0.7% (109/16,268), Qinhuangdao City 1.5% (371/24,693), Tangshan City 3.8% (627/16,623), Baoding City 16.6% (11,722/70,616), Shijiazhuang City 8.0% (12,143/152,061), Cangzhou City 0.7% (152/20,826), Hengshui City 1.0% (160/15,393), Xingtai City 0.7% (72/9,918), and Handan City 1.2% (361/30,026). The difference in GDM prevalence across different regions of Hebei Province was statistically significant (^{2} = 16,919.785, P<0.001). Urban women had a prevalence of 10.6% (19,200/180,369), significantly higher than the 3.7% (6,795/185,843) among rural women (^{2} = 6,779.019, P<0.001).

2.2.2 Hospital Level Distribution From 2014 to 2021, GDM prevalence was 0.7% (34/4,731) in primary hospitals, 3.7% (6,733/180,923) in secondary hospitals, and 10.6% (19,228/180,558) in tertiary hospitals, with statistically significant differences among hospital levels (^{2} = 6,872.8, P<0.001).

2.2.3 Population Distribution Statistically significant differences in GDM prevalence were observed across different age groups, education levels, pregnancy numbers, parity, and prenatal examination frequencies (P<0.05). Specifically, women aged 18-35, 35-40, and $ $40 years had higher prevalence than those <18 years (P<0.05), and women aged 35-40 and $ $40 years had higher prevalence than those aged 18-35 years (P<0.05). Women with university education or higher had higher prevalence than those with high school/junior high school or primary school and below (P<0.05). Women with multiple pregnancies had higher prevalence than those with one pregnancy (P<0.05). Multiparous women had higher prevalence than primiparous women (P<0.05). Women with $ $8 prenatal examinations had higher prevalence than those with <8 examinations (P<0.05) .

2.2.4 Temporal Distribution GDM prevalence was 7.27% (6,583/90,546) in spring (March-May), 6.95% (6,360/91,521) in summer (June-August), 7.08% (6,632/93,729) in autumn (September-November), and 7.10% (6,420/90,416) in winter (December-February). The difference in GDM prevalence across seasons was statistically significant (^{2} = 9.35, P<0.05).

2.2.5 Pregnancy Outcome Distribution No statistically significant differences were found in GDM prevalence among women with different newborn genders or NICU admissions (P>0.05). However, significant differences were observed in GDM prevalence among women with gestational hypertension, anemia, uterine atony, different delivery modes, and macrosomia (P<0.05) .

Discussion

This study demonstrates regional variation in GDM prevalence in Hebei Province, with higher rates in economic centers than surrounding areas, consistent with the province's economic distribution. Baoding (16.60%), Shijiazhuang (8.00%), and Tangshan (3.80%) had higher prevalence, while Zhangjiakou (0.70%) and Xingtai (0.70%) had lower rates. Several factors may explain these differences: (1) Medical resource scarcity and insufficient awareness of GDM among healthcare workers in economically underdeveloped areas of Hebei, along with inconsistent diagnostic criteria and lack of gestational nutrition knowledge, may lead to missed diagnoses. Racial differences, screening protocols, and population characteristic variations across regions may also affect GDM detection rates [16]. (2) Economic centers have higher income levels and differences in dietary habits and living environments; nutritional excess increases obesity and dyslipidemia risk. (3) Environmental pollution in economic centers may reduce glucose metabolism capacity, increasing GDM risk [17-19].

Higher GDM prevalence was observed in urban hospitals and tertiary hospitals, possibly because: (1) Urban areas have higher proportions of tertiary hospitals where pregnant women have stronger awareness of prenatal care and healthcare

workers pay greater attention to GDM screening, enabling timely detection; (2) Higher urban income levels combined with unhealthy dietary habits, irregular eating, and less physical activity; (3) Tertiary hospitals treat more pregnant women with severe complications. Therefore, training on GDM knowledge for healthcare workers in Hebei should be strengthened to improve screening and management capabilities at primary levels, while promoting awareness of perinatal care importance among rural populations and emphasizing regional GDM management for early prevention, detection, and standardized management.

This study found seasonal variation in GDM prevalence, with higher rates in spring and winter than in summer. Possible reasons include: (1) Research has shown vitamin D deficiency increases GDM risk [20-21], and the primary source of vitamin D is skin synthesis from UV radiation. Summer has abundant sunlight, reducing GDM prevalence. (2) Summer heat may reduce appetite and increase consumption of light foods. Therefore, vitamin D supplementation and moderate sun exposure should be encouraged for deficient pregnant women.

Increased GDM prevalence was also found among women with multiple pregnancies and multiparous women, possibly because previous pregnancies may impair glucose metabolism tolerance, increasing GDM risk in subsequent pregnancies [22]. GDM women had higher prevalence of gestational hypertension, likely because abnormal glucose metabolism predisposes to lipid metabolism abnormalities, increasing hypertension risk. Additionally, GDM women had higher rates of anemia and uterine atony, possibly related to dietary restrictions. Macrosomia prevalence was higher in GDM women because maternal hyperglycemia induces fetal hyperinsulinemia, promoting hepatic glycogen deposition, protein synthesis, and fat accumulation, leading to excessive fetal growth. However, no difference in NICU admission rates was observed between groups, suggesting improved glycemic management during labor in GDM women, maintaining stable blood glucose and reducing neonatal hypoglycemia.

This study has limitations: maternal information on pre-pregnancy weight, gestational weight gain, and smoking/alcohol history was not recorded, and lack of such clinical data may limit comprehensive analysis of GDM risk factors. However, this study had broad coverage, large sample size, and strong population representativeness, making the findings valuable.

In summary, analysis of cross-sectional data from 22 hospitals in Hebei Province from 2014 to 2021 shows a year-by-year increase in GDM prevalence. Early screening and prevention should be implemented for high-risk populations including advanced maternal age and multiparous women, with early standardized management and treatment of GDM women to reduce adverse pregnancy outcomes and ensure maternal and infant safety.

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