Follow-up Investigation on the Causes and Complications of Gestational Diabetes Mellitus

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Abstract

Background: Gestational diabetes mellitus (GDM) increases the risk of various complications in both the mother and infant.

Results: By comparing mothers with GDM and non-diabetic pregnant women, we analyzed the possible causes of GDM and the impact on the mother and newborn. Through research and tracking, we found that a sweet tooth and a high total calorie diet are the main factors leading to gestational diabetes. GDM can cause many complications in the parturient and unhealthy babies. A very important result is that our follow-up survey results show that almost all pregnant women with gestational diabetes instructed themselves to have gestational diabetes through a physical examination at a certain time before delivery, but they still suffered from diabetes when they were in the hospital. The harm caused by diabetes has nothing to do with the time of knowing about having diabetes, which shows that pregnant women and their families have not paid enough attention to and make effective treatment of gestational diabetes.

Conclusion: Our results clarify the hazards of gestational diabetes, analyze possible causes, and emphasize the necessity of clinical intervention to control gestational diabetes.

Introduction:

Gestational diabetes mellitus (GDM) is one of the major medical complications during pregnancy[1–3]. According to data from the International Diabetes Federation (IDF) in 2019, the global incidence of hyperglycemia during pregnancy is as high as 15.8%, of which 83.6% are GDM patients. GDM can lead to various pregnancy outcomes. Short-term consequences for mother and offspring included operative delivery, jaundice polyhydramnios, preeclampsia, birth canal lacerations, shoulder dystocia, macrosomia and neonatal hypoglycaemia[4–6]. Perinatal mortality happens in some severe studies of untreated GDM. For long-term consequences, GDM is the best-known risk factor for T2DM112[7]. The risk of hyperglycaemia, diabetes, obesity, cardiovascular disease is increased for offspring of GDM mothers[8].

GDM is a heterogeneous disease, which results from both genetic and environmental factors[9]. Single-nucleotide polymorphisms (SNPs) of several genes which are involved in regulating insulin secretion have been detected to be associated with GDM[10, 11]. Gestational diabetes has a certain relationship with the genetic characteristics of pregnant women, but it is often more affected by diet. On the one hand, in order to ensure the supply of nutrition to the baby, pregnant women may eat more, which may actually cause overnutrition and may cause obesity. On the one hand, women during pregnancy may have greater mental stress, so they may increase their sweet food intake to keep their mood happy. Excessive intake of sweets is undoubtedly prone to cause gestational diabetes. Physical examination during pregnancy is theoretically a good way to help control blood sugar in time and reduce gestational diabetes. Through a follow-up study of 132 pregnant women, we analyzed the possible causes of gestational diabetes, the impact on mother and child health, and the effects of physical examination on GDM.

Participates, Materials And Methods:

We randomly selected 72 pregnant women who were diagnosed with GDM during labor and hospitalization from June 2020 to June 2021 from the pregnant women who were hospitalized, and they had come to our hospital for physical examination during pregnancy before the hospitalization. At the same time, we randomly selected 60 pregnant women who did not have GDM during labor and hospitalization. This research was carried out in accordance with the Declaration of Helsinki. All experimental protocols were approved by the ACT Human Research Ethics Committee. Informed consent was obtained from all subjects and/or their legal guardians.

From the time they were hospitalized to two weeks after giving birth, we conducted continuous follow-up investigations on them and their newborns. Their diet before hospitalization was learned through investigations by their family members. For the judgment of GDM, we adopt the IADPSG= International Diabetes and Pregnancy Research Group's evaluation standard, which is 2 h 75 g oral glucose tolerance test (OGTT), fasting blood glucose ≥ 5.1 mmol/L, or 1 hour blood glucose ≥ 10.0 after taking sugar GDM is considered as GDM, or if the blood glucose is ≥ 8.5 mmol/L 2 h after taking sugar.

Statistical analysis

All statistical analyses were performed using GraphPad Prism software version 6. Significance was analyzed by un-paired two sample parametric t test. **** $P \leq 0.0001$, *** $P \leq 0.0005$, ** $P \leq 0.01$, * $P \leq 0.05$, N.S.: not significant. For scatter plots, horizontal lines and error bars represent the mean values $\pm$ s.d. For box plots, center line indicates median number; box limits, 25% and 75% of the entire population; whiskers, observations within 1.5 $\times$ the interquartile range of the box limits.

Results:

Causes of Gestational diabetes mellitus

First, we analyzed the age of patients with gestational diabetes (Fig. 1a). We found that the average age of pregnant women with gestational diabetes was over 30 at the time of childbirth, and we discovered a new harmful factor for advanced-age birth. This may be related to the decrease in the frequency of people's metabolism with increasing age. Not surprisingly, our results showed that the prevalence of gestational diabetes was not related to height (Fig. 1b), but was affected by weight and BMI (Fig. 1c, d). Our results once again show that obesity is positively correlated with diabetes. Through investigation, we found that the daily caloric intake of pregnant women with gestational diabetes was significantly higher than that of the healthy control group (Fig. 1e). Through further analysis, we found that the reason for the high calorie intake is that pregnant women with gestational diabetes prefer to eat sweets during pregnancy, or they are more likely to feel hungry and eat more frequently (Fig. 1f). In summary, we found that high-calorie and excessive diet are important factors that cause gestational diabetes. Family members are often worried that malnutrition of pregnant women will have a bad impact on the fetus.

However, for countries with relatively affluent material lives, it is possible to control the diet of pregnant women, urge them to eat reasonably, and avoid gestational diabetes is a more sensible choice.

Complications of GDM in the parturient

We analyzed some symptoms of pregnant women with gestational diabetes during their hospitalization to clarify the impact of gestational diabetes on the health of mothers and children. First of all, our analysis found that the prenatal pregnancy time of gestational diabetes is shorter than that of healthy pregnant women (Fig. 2a). Although this reduces the burden of pregnant women to a certain extent, it may lead to unhealthy babies. Pregnant women with gestational diabetes mellitus have a significantly longer hospital stay than healthy women, implying a higher probability of birth complications and a worse prognosis (Fig. 2b). Sure enough, compared with healthy pregnant women, pregnant women with gestational diabetes have a much higher rate of hyperlipidemia, high blood pressure, inflammation (vaginitis, urethritis), and they are also accompanied by premature rupture of membranes, too much or too little amniotic fluid. Directly related diseases (Fig. 2c). Some pregnant women with gestational diabetes also show disorders of thyroid function. Compared with the control group of healthy pregnant women, the probability of complications caused by the operation itself is slightly increased in pregnant women with gestational diabetes (Fig. 2d). Of course, this may be related to the fact that the probability of caesarean section of pregnant women with diabetes is much higher than that of the healthy control group (Fig. 2f). In addition, the results of the 42-day re-examination showed that pregnant women with gestational diabetes are much more likely to have sequelae of childbirth than pregnant women with gestational diabetes, and a higher proportion of pregnant women still see hyperglycemia (Fig. 2e). In summary, gestational diabetes has a significant adverse effect on the health of pregnant women. As a doctor and family members, we should pay enough attention to it.

Complications of GDM in the infant

Newborns born to pregnant women with gestational diabetes are significantly heavier than those born to healthy pregnant women in the control group (Fig. 3a), which may be related to the high-calorie diet of pregnant women. Newborns born to pregnant women with gestational diabetes have a significantly higher probability of developing diseases such as hypoglycemia and jaundice than those born to healthy pregnant women in the control group (Fig. 3b). Re-examination after two weeks showed that the probability of newborns born to pregnant women with gestational diabetes was significantly higher than that of newborns born to healthy pregnant women in the control group (Fig. 3c). This result may be related to the mother's complications during childbirth.

The influence of the diagnosis time of gestational diabetes on the newborn mother and child

We conducted a "retrospective" survey on pregnant women with gestational diabetes. Through their physical examination reports during pregnancy, we found that almost all pregnant women with

gestational diabetes knew that they had diabetes before giving birth, and the hospital gave certain treatments after they were detected. However, considering the test results of their labor and hospitalization-they all have diabetes, it can be known that the diabetes found in their physical examination results has not been well treated and controlled. Not surprisingly, our results show that neither the health status of pregnant women nor the health status of newborns has anything to do with when pregnant women with gestational diabetes learned that they had diabetes (Fig. 4). Although it is a result of no significant difference, this result is alarming. It is undoubtedly that diabetes was detected during pregnancy and did not receive enough attention, and the lack of continuous treatment led to the diagnosis of diabetes when the pregnant woman gave birth. Gestational diabetes has an adverse effect on the health of pregnant women and babies.

Conclusions

Our results found that excess, high-calorie diet and increased intake of sweets during pregnancy are important causes of obesity and GDM. GDM can cause diseases of pregnant women and newborns, including perinatal complications and neonatal diseases of pregnant women during delivery, and postpartum sequelae and neonatal diseases of pregnant women after delivery. We found that almost all pregnant women with gestational diabetes knew that they had diabetes before they gave birth, and the hospital gave certain treatments after they were detected. The health status of pregnant women and the health status of newborns have nothing to do with when pregnant women with gestational diabetes learned that they have diabetes. Undoubtedly, the detection of diabetes during pregnancy has not received enough attention by pregnant women and their families who were supposed to make voluntary efforts to avoid GDM, which emphasizes the importance of doctors intervening in pregnant women's blood sugar. Our research stays at the level of phenotypic detection and cannot explain the underlying mechanism of the complex physiological milieu. In the future, we will combine single-cell sequencing technology and cytokine detection technology for further analysis.

Declarations

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Author Contributions F.W. conceived the project, designed the experiments and performed data analysis. H.C. collected the clinical results. M.L. helped in the Clinical analysis. F.W. wrote the manuscript with input from all authors.

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Ethics approval and consent to participate

This research was carried out in accordance with the Declaration of Helsinki. All experimental protocols were approved by the ACT Human Research Ethics Committee. Informed consent was obtained from all subjects and/or their legal guardians.

Competing interests

The authors declare no competing interests

Consent for publication

Not applicable

Availability of data and materials

The results were analyzed from original clinical cases from Jin Xiang People's Hospital. To protect the privacy of participants, raw data were not published. Requests for access to the original clinical cases can be obtained by contacting the corresponding author Fang Wang by email at lbswysz@163.com.

References

1. Sacks DA, Hadden DR, Maresh M, Deerochanawong C, Dyer AR, Metzger BE, Lowe LP, Coustan DR, Hod M, Oats JJN *et al*: **Frequency of gestational diabetes mellitus at collaborating centers based on IADPSG consensus panel-recommended criteria: the Hyperglycemia and Adverse Pregnancy Outcome (HAPO) Study**. *Diabetes Care* 2012, **35**(3):526–528.
2. Alfadhli EM: **Gestational diabetes mellitus**. *Saudi Med J* 2015, **36**(4):399–406.
3. Crowther CA, Hiller JE, Moss JR, McPhee AJ, Jeffries WS, Robinson JS: **Effect of Treatment of Gestational Diabetes Mellitus on Pregnancy Outcomes**. *New England Journal of Medicine* 2005, **352**(24):2477–2486.
4. Yogev Y, Xenakis EMJ, Langer O: **The association between preeclampsia and the severity of gestational diabetes: The impact of glycemic control**. *American Journal of Obstetrics and Gynecology* 2004, **191**(5):1655–1660.
5. Ehrenberg HM, Durnwald CP, Catalano P, Mercer BM: **The influence of obesity and diabetes on the risk of cesarean delivery**. *American Journal of Obstetrics and Gynecology* 2004, **191**(3):969–974.
6. Kijmanawat A, Panburana P, Reutrakul S, Tangshewinsirikul C: **Effects of probiotic supplements on insulin resistance in gestational diabetes mellitus: A double-blind randomized controlled trial**. *J Diabetes Investig* 2019, **10**(1):163–170.
7. Cheung NW, Byth K: **Population Health Significance of Gestational Diabetes**. *Diabetes Care* 2003, **26**(7):2005.

8. McIntyre HD, Catalano P, Zhang C, Desoye G, Mathiesen ER, Damm P: **Gestational diabetes mellitus.** *Nature Reviews Disease Primers* 2019, **5**(1):47.
9. Chen L, Magliano DJ, Zimmet PZ: **The worldwide epidemiology of type 2 diabetes mellitus—present and future perspectives.** *Nature Reviews Endocrinology* 2012, **8**(4):228–236.
10. Ding M, Chavarro J, Olsen S, Lin Y, Ley SH, Bao W, Rawal S, Grunnet LG, Thuesen ACB, Mills JL *et al*: **Genetic variants of gestational diabetes mellitus: a study of 112 SNPs among 8722 women in two independent populations.** *Diabetologia* 2018, **61**(8):1758–1768.
11. Ren J, Xiang AH, Trigo E, Takayanagi M, Beale E, Lawrence JM, Hartiala J, Richey JM, Allayee H, Buchanan TA *et al*: **Genetic variation in MTNR1B is associated with gestational diabetes mellitus and contributes only to the absolute level of beta cell compensation in Mexican Americans.** *Diabetologia* 2014, **57**(7):1391–1399.

Figures

Figure 1

Causes of Gestational diabetes mellitus. a,b,c,d,e independently shows the age, height, weight, BMI, dietary calories of pregnant women with GDM (GDM+, shown in red) or without GDM (GDM-, shown in blue). f, pie chart of dietary change of pregnant women. Horizontal lines and error bars represent the mean values $\pm$ s.e. of three or more independent biological replicates (GDM+, 72 women, GDM-, 60 women). Significance was analyzed by un-paired two sample parametric t test. **** $P \leq 0.0001$, *** $P \leq 0.0005$, ** $P \leq 0.01$, * $P \leq 0.05$, N.S.: not significant.

Figure 2

Complications of GDM in the parturient. a,b independently shows the pregnant time or hospital stay of pregnant women with GDM (GDM+, shown in red) or without GDM (GDM-, shown in blue).c shows pregnant complications of mothers. d,e,f show surgical complications, disease after pregnancy or delivery method of pregnant women with GDM (upper) or without GDM (lower). For lines and statistics in a and b see the description in the legend of Figure 1.

Figure 3

Complications of GDM in the infant. a,b independently shows the weight and disease of the newborn with GDM (GDM+, shown in red) or without GDM (GDM-, shown in blue). c, pie chart of diseases of babies two week after birth. For lines and statistics in a see the description in the legend of Figure 1.

Figure 4

The influence of the diagnosis time of gestational diabetes on the newborn mother and child. a,b,c,d,e,f independently shows diagnosis time (days) of different groups of pregnant women. Horizontal lines and error bars represent the mean values $\pm$ s.e. of three or more independent biological replicates ($n \geq 10$ mothers). Significance was analyzed by un-paired two sample parametric t test. **** $P \leq 0.0001$, *** $P \leq 0.0005$, ** $P \leq 0.01$, * $P \leq 0.05$, N.S.: not significant.

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