

ABSTRACT

Objective

This study aimed to assess the association between first trimester glucose profiles, using continuous glucose monitoring (CGM), and later development of gestational diabetes mellitus (GDM), potentially offering earlier detection.

Design

This prospective observational study involved 89 pregnant women, 42 of which developed GDM. All women had assessment of glucose profiles using CGM in the first trimester of pregnancy.

Methods

Participants were randomly selected, with inclusion criteria limited to women with uncomplicated pregnancies (no pre-existing conditions, hypertensive disorders, or diabetes). Maternal demographic data, including age, parity, ethnicity, smoking habits, and method of conception, were recorded at first visit. Maternal biophysical measurements were obtained at the first visit (11-14 weeks) and CGM (Dexcom G6 system) was used for 10 days. The CGM metrics analysed were mean glucose, glucose variability (GV), time in range (TIR 3.5-7.8mmol/L), time above range (TAR >7.8mmol/L), time below range (TBR < 3.5 and < 3.0mmol/L) and glucose management indicator (GMI).

Introduction

Although GDM can be diagnosed at any stage of pregnancy (1), the widely recommended OGTT is traditionally performed between 26-28 weeks (2,3) and therefore is limited in its ability to provide an early comprehensive picture of glycaemic patterns. Self-monitoring blood glucose (SMBG) offers real-time data and is recommended early in pregnancy for women with previous GDM (2), showing better sensitivity and specificity than OGTT at detecting hyperglycaemia in some studies (4). However, there remains no clear consensus on the definition of an abnormal result with thresholds varying across studies (4,5). Early screening tools such as HbA1c have also been used but have been associated with poor sensitivity for GDM and strong correlations with pregnancy outcomes are yet to be established (6,7).

Early glucose levels in pregnancy, even below the current diagnostic test for GDM have been linked to pregnancy complications in women with risk factors for GDM (8). A metanalysis suggested that early-onset GDM led to higher risk of developing pregnancy-related complications when compared to late-onset GDM despite treatment (9). CGM offers a more detailed and continuous view of glucose patterns throughout pregnancy, enabling the detection of fluctuations that may be missed with OGTT and SMBG (10).

Results

Women that developed GDM revealed significant differences in glycaemic profiles and pregnancy outcomes, highlighting the metabolic burden of gestational diabetes. They exhibited a higher booking BMI (p = 0.05), significantly elevated HbA1c (p = 0.001) fasting (GTT-0) (p < 0.001) and post-glucose load (GTT-120) (p < 0.001) glucose levels and delivered earlier (p = 0.02). The longitudinal mixed effects model analysis demonstrated that mean glucose (p < 0.001), percentage TAR (p < 0.001) and GMI (p < 0.01), were significantly higher in the GDM group and the percentage TIR was markedly lower in patients with GDM (p < 0.001). These cumulative differences were detectable as early as the first trimester, suggesting that glycaemic disturbances precede GDM diagnosis and are potentially predictive

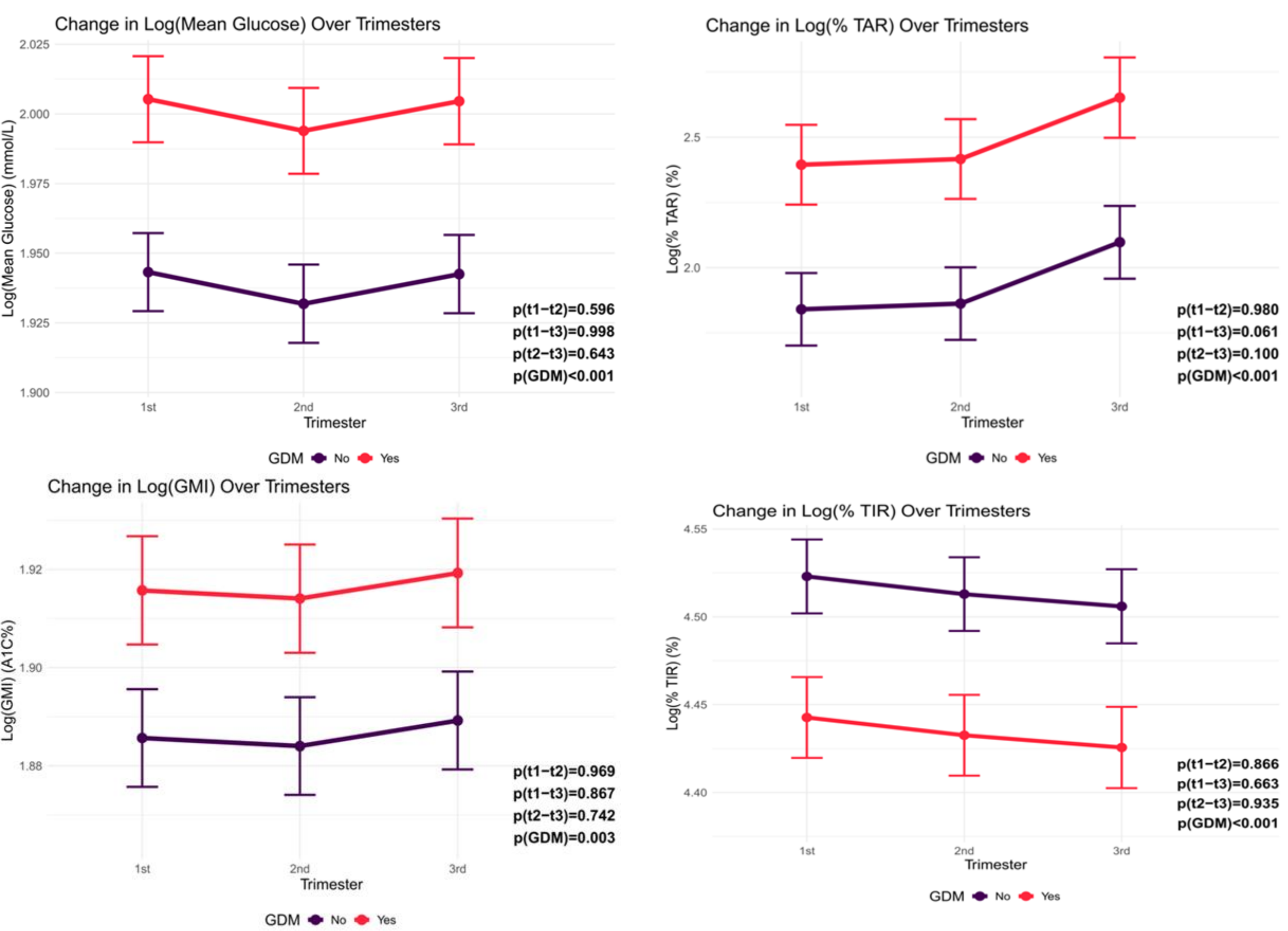
After applying linear regression models, several key first-trimester CGM metrics were significantly associated with the development of GDM such as; mean glucose, TIR, TAR, and TBR. A 1 mmol/L increase in mean glucose increased GDM odds by over fourfold (aOR = 4.20, p < 0.01). Each 1% rise in TIR reduced the likelihood of GDM by 10% (aOR = 0.90, p = 0.01), while a 1% increase in TAR increased the odds by 13% (aOR = 1.13, p <0.01). A 1% rise in TBR halved the GDM risk (aOR = 0.43, p = 0.04).

Variable	Group 1 (No GDM)		Group 2 (GDM)		p-value
	N		N		
Age (years)	47	32.96 (5.67)	42	34.43 (5.05)	0.20
White ethnicity (n, %)	47	Yes: 29 (61.7%), No: 18 (38.3%)	42	Yes: 26 (61.9%), No: 16 (38.1%)	> 1.0
Smoking (n, %)	47	No: 46 (97.9%), Yes: 1 (2.1%)	42	No: 40 (95.2%), Yes: 2 (4.8%)	0.92
Parity (n, %)	47	No: 23 (48.9%), Yes: 24 (51.1%)	42	No: 15 (35.7%), Yes: 27 (64.3%)	0.30
Assisted conception (n, %)	47	No: 41 (87.2%), Yes: 6 (12.8%)	42	No: 38 (90.5%), Yes: 4 (9.5%)	0.88
Booking BMI (Kg/m²)	47	34.45 (28.04 – 37.66)	42	36.36 (7.32)	0.05
Gestational age at delivery (weeks)	47	39.29 (38.57 - 40.07)	42	38.43 (37.57 – 39.11)	< 0.01
HbA1c (%)	46	32.8 (2.73)	42	35.38 (3.92)	< 0.01
GTT-0 (mmol/L)	46	4.24 (0.31)	42	4.60 (4.40-5.00)	< 0.001
GTT-120 (mmol/L)	46	5.4 (0.91)	38	7.23 (1.72)	< 0.001
Birth weight (g)	47	3320 (3016 - 3625)	42	3207.43 (553.07)	0.25
Birth weight percentile (%)	47	53.00 (23.0 - 74.50)	42	49.17 (29.49)	0.96
LGA neonate (n, %)	47	No: 44 (93.6%), Yes: 3 (6.4%)	42	No: 38 (90.5%), Yes: 4 (9.5%)	0.88
SGA neonate (n, %)	47	No: 44 (93.6%), Yes: 3 (6.4%)	42	No: 38 (90.5%), Yes: 4 (9.5%)	0.88
Neonatal percentage fat mass (%)	28	9.99 (3.48)	30	9.82 (3.56)	0.85
Neonatal abdominal circumference (cm)	30	32.42 (2.13)	32	32.75 (1.85)	0.52
Table: Demographic characteristics, biophysical measurements and pregnancy outcomes. Data are expressed as mean (Standard Deviation), median (Interquartile Range) or number (%).					

Discussion and conclusions

CGM metrics in the first trimester are strongly associated with GDM development, with mean glucose and TAR correlating with increased GDM risk, while higher TIR reduces the likelihood. This emphasizes that GDM can be detected earlier in pregnancy. However, it remains to be determined whether management of GDM earlier in pregnancy can prevent adverse outcomes associated with GDM including excessive fetal growth and adiposity. These findings reinforce the utility of CGM in providing a more comprehensive and continuous assessment of glycaemic patterns and challenges the adequacy of more traditional methods like the OGTT and SMBG.

More broadly, this study underscores the need for further research to establish standardised CGM-based glycaemic targets in pregnancy and supports the integration of CGM into risk stratification algorithms and GDM care pathways, lending to a more first-trimester-centred model of antenatal care (11). With the ultimate goal being earlier intervention, personalised glycaemic management and improved maternal-fetal outcomes.



Figures: Graphical representation of longitudinal mixed effects model analysis of CGM metrics across pregnancy trimesters, comparing GDM vs. no GDM

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