

Mid-trimester small fetal abdominal circumference and femur length are associated with elevated risk of diabetes among Bangladeshi adolescents.

BACKGROUND

Fetal growth restriction is a worldwide health issue that significantly diminishes the quality of life by contributing to the development of chronic health conditions later in life. Vital fetal organs are formed and developed during early to mid-pregnancy. Therefore, any adverse intrauterine environment during this period might significantly affect the health of offspring in adulthood. However, the impact of early fetal growth restriction on the risk of diabetes in adolescents is underexplored.

This study aimed to identify the effect of mid-trimester fetal growth restriction (as measured by abdominal circumference and femur length) on diabetic biomarkers (FBG, HbA1c) among Bangladeshi adolescents.

METHODS

- Study design, population and area:** A longitudinal cohort study embedded in a population-based food and maternal micronutrient supplementation trial in Matlab, Bangladesh among 4436 pregnant women. The participants were invited before gestational weeks (GW) 13 to confirm pregnancy and for antenatal checkups with ultrasound assessments at 14, 19, and 30 GW. At 15 years, 502 children in the immune cohort who provided immune profiles were followed up from the mother-children cohort.
- Fetal growth biomarkers:** Femur length (FL) was measured from one end to the other, capturing a complete femoral image and the abdominal circumference (AC) was measured at the level of the umbilical portion of the left portal vein using an ellipse curve. FL and AC were standardized by gestational weeks, and the z-score was calculated using Chitty's formula. This study included ACz score and FLz score at GWs14 and 19.
- Diabetic biomarkers:** The fasting blood glucose (FBG) and HbA1c were determined in plasma and whole blood samples.
- Statistical analyses:** Multivariable linear regression analysis (generalized linear model) was used to identify the effect of fetal FL and AC at GW 14 and 19 on diabetic biomarkers at 15 years old. Mothers' food and supplementation groups, parity, child sex, and BMI were considered as covariates.

RESULTS

- Out of the 502 participants, 433 were included in the final analysis (n=42 refusal to blood collection; n=27 invalid birth anthropometrics).
- Only 3.5% of adolescents had elevated FBG (100-125 mg/dl), and 27.8% were found prediabetic (HbA1c \geq 5.7%).
- The mean of maternal age was 25.9 with SD 5.9. Mean maternal BMI was 20.5 (SD 2.9) and mean adolescents BMI was 19.1 (SD 3.5).
- 47.3% of the adolescents were male. 22.4% had low birthweight (<2500gm) and 5.1% had preterm birth (<37 gestational weeks).

RESULTS CONTINUED

Table 1. Association of ACz score and diabetic biomarkers among 15 years adolescents

Biomarkers	ACz at GW14 (n= 433)		ACz at GW19 (n= 424) ¹	
	β (95% CI)	p-value	β (95% CI)	p-value
FBG (mg/dl)	-0.40 (-0.72, -0.08)	0.013	-0.45 (-0.92, 0.01)	0.060
HbA1c ² (%)	-0.01 (-0.02, -0.004)	0.004	-0.01 (-0.02, 0.001)	0.071

¹Missing value (n=9), ²Missing value (n=2).

One standard deviation decrease in ACz-score was associated with higher FBG and HbA1c level at GW 14 (β = -0.40, p=0.013 and β = -0.01, p=0.004, respectively). Also, FLz-score was inversely associated at GA 14 and 19 with FBG (β = -0.44, p=0.048 and β = -0.59, p=0.031) and HbA1c (β =-0.01, p=0.007 and β =-0.01, p=0.018).

Table 2. Association of FLz score and diabetic biomarkers among 15 years adolescents

Biomarkers	FLz at GW14 (n= 433)		FLz at GW19 (n= 424) ¹	
	β (95% CI)	p-value	β (95% CI)	p-value
FBG (mg/dl)	-0.44 (-0.88, -0.004)	0.048	-0.59 (-1.12, -0.05)	0.031
HbA1c ² (%)	-0.01 (-0.03, -0.005)	0.007	-0.01 (-0.03, -0.003)	0.018

¹Missing value (n=9), ²Missing value (n=2).

STUDY FINDINGS AND CONCLUSION

- Mid-trimester restricted fetal abdominal circumference and femur length may be associated with elevated risk of diabetes among Bangladeshi 15-year-old adolescents.**
- Fetal growth restriction is a significant public health concern contributing not only to child morbidity and mortality but also to long-term cardiometabolic health in adulthood.
- Promoting education on pre-pregnancy nutrition and healthy fetal development is essential to mitigating the risk of diabetes later in life.

ADDITIONAL KEY INFORMATION

Conflicts of Interest

The authors declare no conflict of interests.

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