

Table 1—Adjusted* linear regression coefficients for associations of glucose tolerance status during pregnancy and offspring’s overall and central adiposity as well as glycemic indices at early adolescence

	Male offspring		Female offspring	
	Model 1	Model 2	Model 1	Model 2
Overall adiposity				
BMI, z score	(N = 439)		(N = 441)	
NGT	Ref	Ref	Ref	Ref
IH	0.20 (−0.18, 0.57)	0.09 (−0.25, 0.44)	0.30 (−0.00, 0.60)	0.14 (−0.13, 0.41)
GIGT	−0.17 (−0.67, 0.32)	−0.26 (−0.72, 0.20)	0.26 (−0.37, 0.90)	0.25 (−0.32, 0.81)
GDM	0.08 (−0.37, 0.53)	−0.12 (−0.54, 0.30)	0.50 (0.04, 0.96)	0.12 (−0.29, 0.54)
Sum of skinfolds, mm	(N = 438)		(N = 440)	
NGT	Ref	Ref	Ref	Ref
IH	0.49 (−4.42, 5.40)	−0.88 (−5.42, 3.66)	4.84 (1.06, 8.63)	3.00 (−0.38, 6.39)
GIGT	−0.93 (−7.41, 5.55)	−2.17 (−8.15, 3.80)	1.98 (−5.96, 9.91)	1.96 (−5.12, 9.04)
GDM	2.71 (−3.20, 8.61)	−0.11 (−5.63, 5.41)	0.59 (−5.12, 6.31)	−3.74 (−8.93, 1.45)
DXA whole-body fat, %	(N = 301)		(N = 322)	
NGT	Ref	Ref	Ref	Ref
IH	0.29 (−3.32, 3.89)	0.28 (−3.08, 3.65)	3.39 (1.27, 5.51)	1.92 (−0.01, 3.83)
GIGT	0.26 (−4.17, 4.70)	−0.56 (−4.71, 3.58)	1.65 (−3.80, 7.09)	1.92 (−2.94, 6.78)
GDM	2.39 (−1.87, 6.66)	0.14 (−3.95, 4.22)	1.37 (−2.11, 4.85)	−1.10 (−4.29, 2.09)
DXA fat mass index, kg/m ²	(N = 301)		(N = 322)	
NGT	Ref	Ref	Ref	Ref
IH	−0.19 (−1.60, 1.21)	−0.19 (−1.48, 1.09)	1.38 (0.44, 2.31)	0.63 (−0.17, 1.44)
GIGT	−0.07 (−1.80, 1.66)	−0.43 (−2.01, 1.16)	0.26 (−2.13, 2.66)	0.37 (−1.67, 2.41)
GDM	1.27 (−0.39, 2.94)	0.27 (−1.29, 1.84)	0.61 (−0.92, 2.14)	−0.76 (−2.09, 0.58)
Central adiposity				
Waist circumference, cm	(N = 439)		(N = 441)	
NGT	Ref	Ref	Ref	Ref
IH	1.58 (−2.75, 5.91)	0.39 (−3.64, 4.42)	3.02 (−0.15, 6.20)	1.35 (−1.42, 4.12)
GIGT	0.24 (−5.48, 5.95)	−0.81 (−6.11, 4.50)	1.76 (−4.89, 8.41)	1.58 (−4.21, 7.37)
GDM	2.71 (−2.50, 7.91)	0.43 (−4.47, 5.33)	2.38 (−2.41, 7.18)	−1.77 (−6.01, 2.48)
DXA truncal fat mass, kg	(N = 301)		(N = 322)	
NGT	Ref	Ref	Ref	Ref
IH	−0.22 (−1.99, 1.55)	−0.22 (−1.85, 1.40)	1.70 (0.53, 2.88)	0.78 (−0.24, 1.80)
GIGT	0.06 (−2.11, 2.24)	−0.37 (−2.38, 1.63)	0.32 (−2.70, 3.34)	0.45 (−2.13, 3.03)
GDM	1.20 (−0.89, 3.30)	−0.07 (−2.04, 1.90)	1.01 (−0.93, 2.94)	−0.72 (−2.41, 0.97)
DXA truncal to peripheral fat ratio	(N = 301)		(N = 322)	
NGT	Ref	Ref	Ref	Ref
IH	0.00 (−0.04, 0.05)	0.00 (−0.04, 0.05)	0.05 (0.01, 0.09)	0.03 (−0.01, 0.07)
GIGT	−0.02 (−0.08, 0.04)	−0.03 (−0.08, 0.03)	0.00 (−0.10, 0.10)	0.00 (−0.09, 0.10)
GDM	0.02 (−0.03, 0.08)	0.00 (−0.06, 0.05)	0.04 (−0.02, 0.11)	0.00 (−0.06, 0.07)
Skinfold ratio (SS:TR)	(N = 438)		(N = 440)	
NGT	Ref	Ref	Ref	Ref
IH	−0.05 (−0.13, 0.04)	−0.06 (−0.14, 0.02)	0.04 (−0.02, 0.11)	0.03 (−0.04, 0.09)
GIGT	0.01 (−0.10, 0.12)	−0.00 (−0.11, 0.11)	0.02 (−0.11, 0.15)	0.02 (−0.11, 0.15)
GDM	0.01 (−0.09, 0.11)	−0.03 (−0.13, 0.07)	−0.00 (−0.10, 0.09)	−0.04 (−0.13, 0.06)
Glycemic indices				
Fasting glucose, mg/dL	(N = 263)		(N = 240)	
NGT	Ref	Ref	Ref	Ref
IH	−3.8 (−12.3, 4.8)	−3.9 (−12.5, 4.7)	1.5 (−2.8, 5.8)	0.7 (−3.6, 5.0)
GIGT	−4.6 (−17.4, 8.2)	−4.6 (−17.5, 8.2)	−5.9 (−14.1, 3.3)	−5.9 (−15.0, 3.2)
GDM	−0.2 (−11.5, 11.1)	−0.7 (−12.3, 10.9)	−7.2 (−14.8, 0.5)	−9.6 (−17.3, −1.9)
Fasting insulin, μU/mL	(N = 263)		(N = 240)	
NGT	Ref	Ref	Ref	Ref
IH	14.9 (−13.5, 52.7)	12.6 (−14.8, 48.8)	9.5 (−11.6, 35.6)	7.0 (−13.4, 32.3)
GIGT	1.9 (−33.4, 56.1)	2.0 (−32.8, 54.8)	15.4 (−27.0, 82.4)	16.9 (−25.5, 83.3)
GDM	23.9 (−14.9, 80.4)	13.1 (−22.4, 65.0)	−7.2 (−36.4, 35.5)	−17.9 (−43.9, 20.2)
HOMA-IR	(N = 263)		(N = 240)	
NGT	Ref	Ref	Ref	Ref
IH	11.5 (−16.1, 48.2)	9.2 (−17.3, 44.2)	11.7 (−10.2, 38.9)	8.4 (−12.5, 34.3)
GIGT	0.0 (−34.7, 53.2)	0.0 (−34.1, 51.7)	8.8 (−31.8, 73.7)	10.3 (−30.1, 74.1)
GDM	26.2 (−13.4, 83.9)	14.9 (−21.2, 67.6)	−13.5 (−41.2, 27.2)	−25.3 (−49.2, 10.0)

Data are β (95% CI) except for fasting insulin and HOMA-IR, which are expressed as % difference (95% CI). SS, subscapular; TR, triceps. *Model 1: adjusted for age at early adolescence visit, maternal age, race/ethnicity, education, parity, smoking during pregnancy, marital status, household income, and paternal history of type 1 or type 2 diabetes (for glycemic indices only); model 2: model 1 additionally adjusted for paternal BMI and maternal prepregnancy BMI.

gestational weight gain and found similar results, whereas adjusting for puberty slightly strengthened the associations in female offspring from IH mothers.

Our study had the following limitations. We could not account for the level of glycemic control or the type of GDM treatment, and we did not assess whether some women without GDM received nutritional/lifestyle counseling during pregnancy. Despite the considerable number of participants included, we were limited by our relatively small sample in IH/GIGT/GDM groups and by the fact that our sample was mostly white, with a generally high socioeconomic status, limiting generalizability. Finally, variability in child glycemic indices was relatively low, possibly due to participant age at examination.

In this prospective longitudinal pre-birth cohort, we did not observe independent associations of abnormal gestational glucose tolerance with adiposity and IR in early adolescence. Some of the effect estimates in early adolescence were similar in size and direction with respective

outcomes measured in mid-childhood (4), but CIs of our associations with outcomes measured at early adolescence were larger and overlapping with the null. The large variability in adiposity and IR changes associated with the transition to adolescence and puberty could explain the lack of associations. GDM treatment may also have attenuated the associations. Longer follow-up will help reveal whether associations of abnormal glucose tolerance in pregnancy with offspring adiposity and IR are observable after the adolescent hormonal transition.

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Author Contributions. V.G. and M.-F.H. designed the analysis. V.G. analyzed and interpreted the data and drafted the manuscript. S.L.R.-S. provided guidance on statistical analysis.

S.L.R.-S., I.P.M.D., I.M.A., E.O., and M.-F.H. provided critical intellectual contributions and read and approved the final manuscript. V.G. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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