Nutritional risk factors for the development of type 2 diabetes in women with GDM

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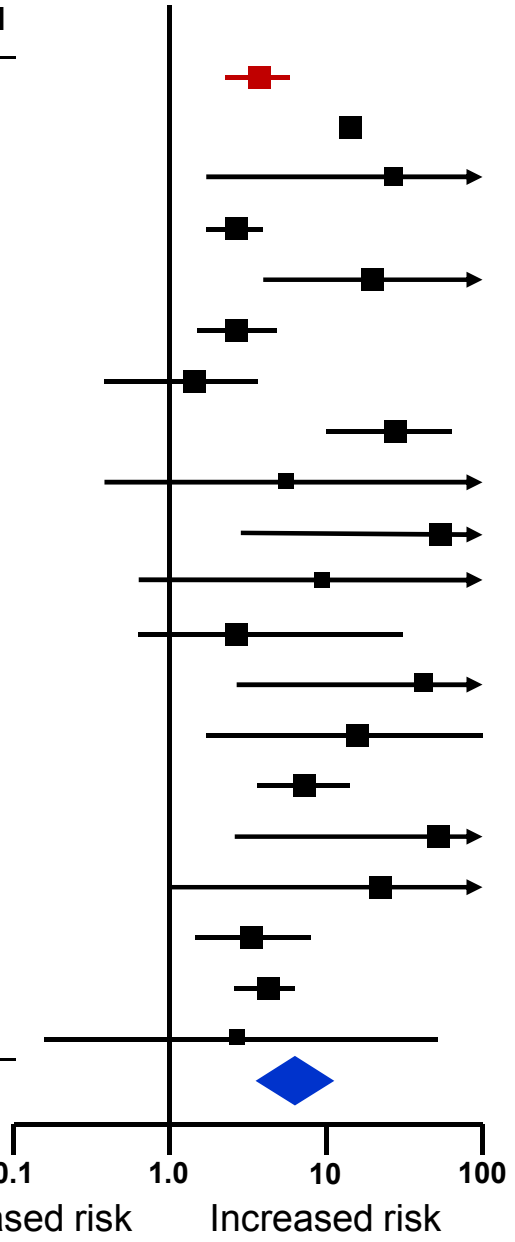
Contents

- Incidence and risk factors of T2DM in women with GDM
- Nutritional risk factors for early development of diabetes in women with GDM
- Postpartum follow up and prevention of type 2 diabetes

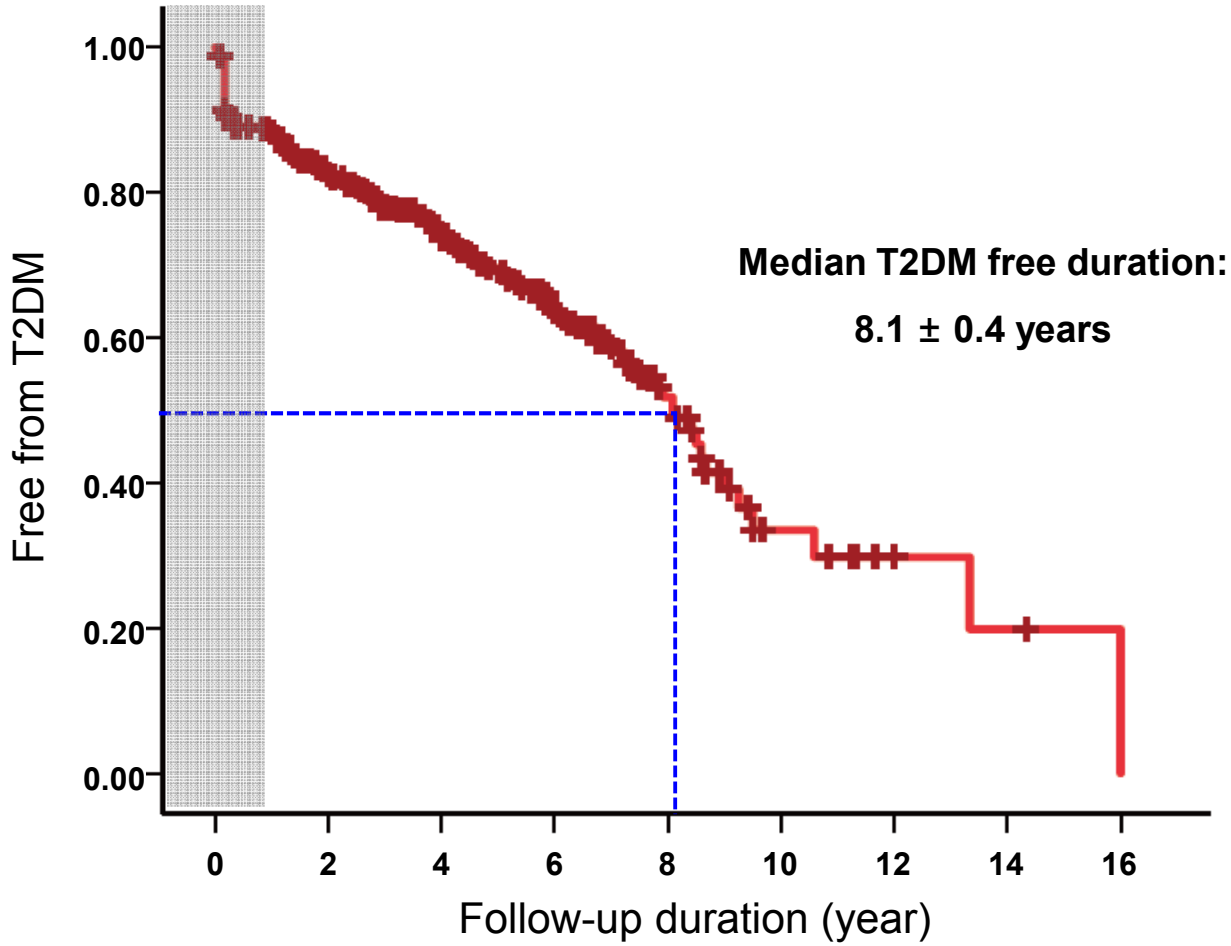
Risk of T2DM after GDM

Study	Year	Country	T2DM/GDM	T2DM/no GDM	RR	(95%CI)
Lee H et al	**1995-1997**	**Korea**	**71/620**	**22/868**	**4.52**	**(2.83-7.21)**
Feig et al	1995-2002	Canada	2,874/21,823	6,628/637,341	12.66	(12.15-13.19)
Madarasz et al	1995	Hungary	21/68	0/39	24.93	(1.55-400.64)
Gunderson et al	1985-2006	USA	43/166	150/2,242	3.87	(2.87-5.22)
Vambergue et al	1992	France	53/295	1/111	19.94	(2.79-142.47)
Lee A et al	1971-2003	Australia	405/5,470	16/783	3.62	(2.21-5.93)
Ferraz et al	2007	Brazil	6/70	7/108	1.32	(0.46-3.78)
Krishnaveni et al	1997-1998	India	13/35	8/489	22.70	(10.09-51.08)
Morimitsu et al	1999-2001	Brazil	7/23	0/11	7.50	(0.47-120.11)
Jarvela et al	1984-1994	Finland	23/435	0/435	47.00	(2.86-771.65)
Albareda et al	1966-1993	Spain	44/696	0/70	9.07	(0.56-146.25)
Aberg et al	1991-1999	Sweden	21/229	1/61	5.59	(0.77-40.66)
Linne et al	1964-1965	Sweden	10/28	0/52	38.38	(2.33-631.74)
Bian et al	1964-1965	China	15/45	1/39	13.00	(1.80-93.93)
Ko et al	1988-1995	China	105/801	7/431	8.07	(3.79-17.19)
Osei et al	1990-1991	USA	10/15	0/35	47.25	(2.95-757.28)
Damm et al	1978-1985	Denmark	33/241	0/57	16.06	(1.00-258.06)
Benjamin et al	1961-1988	USA	14/47	3/47	4.67	(1.43-15.21)
O'Sullivan et al	1962-1970	USA	224/615	18/328	6.64	(4.19-10.52)
Persson et al	1961-1984	Sweden	5/145	0/41	3.16	(0.18-55.76)
Total			**3,997/31,867**	**6,862/643,588**	**7.43**	**(4.79-11.51)**



Bellamy et al. Lancet 2009

Incidence of T2DM after GDM in Koreans



Risk factors for conversion from GDM to type 2 diabetes

- Fasting glucose value on OGTT
- Obesity precedes pregnancy
- Postpartum weight gain
- GDM diagnosed before the 24th week of pregnancy
- Relative insulinopenic response to oral glucose
- The requirement for insulin in pregnancy
- Family history of type 2 diabetes, esp. on the maternal side
- Maternal age
- Parity
- Previous history of GDM

Background

- Early detection of postpartum glucose intolerance in GDM women with subsequent monitoring of glucose tolerance is recommended

- Early identification of risk factors for developing type 2 diabetes in GDM women could assist in establishing interventions and identifying candidates for treatment

- Although nutrient intake affect known risk factors for postpartum T2DM, such as body weight and body fat, no studies have investigated the relation between nutrient intakes and postpartum diabetes in women with GDM

Objective

- To identify possible risk factors for early development of type 2 diabetes by anthropometric, biochemical, and nutrient assessments in women with GDM

Subjects

- 17,107 pregnant women using a universal two-step screening for GDM at 24-28 weeks of gestation between 2006 and 2009.
- 882 women were diagnosed as GDM and 573 women did postpartum follow up. (44.8% prediabetes, 5.2% DM)

  : classify glucose tolerance status at 6-12 week postpartum by a 75 g OGTT
- A total of 381 women included in this study

  (193 NGT, 161 prediabetes, and 27 type 2 diabetes)
- Prediabetes : collectively refers to IGT, IFG, and combined IFG/IGT

Methods

- **Questionnaires: age, prepregnancy weight, obstetric history including gestational age and parity, and family history of diabetes among first-degree relatives**
- **Activity: by activity recall**
- **Energy expenditure: calculated by equation with basal energy expenditure and activity levels**
- **Nutrient intake: calculated using CAN-Pro from food intake taken by 24 h recall methods**
- **Biochemical parameters: HOMA-IR, HOMA-B, lipid profile, HbA_{1c}**
- **Statistical analysis**

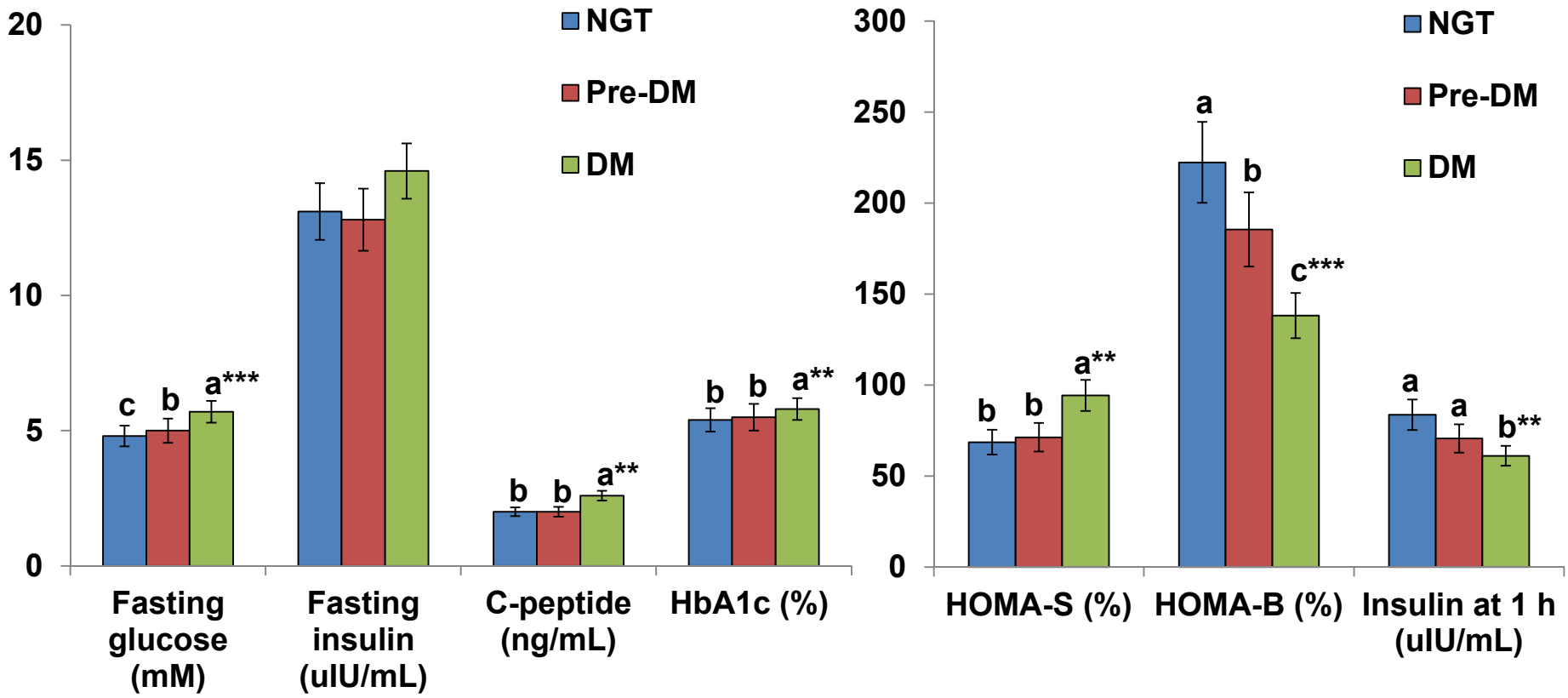
Baseline characteristics of subjects stratified by glucose tolerance status at 6-12 weeks postpartum

	NGT (n=193)	Prediabetes (n=161)	T2DM (n=27)	P value
Age (yrs)	33.6 ± 3.6	34.2 ± 3.7	34.9 ± 3.5	0.18
Height (cm)	159.5 ± 5.0	159.6 ± 5.3	159.7± 4.9	0.88
Prepregnancy BW (kg)	57.3 ± 9.3[b]	59.9 ± 10.0[a]	63.6 ± 10.4[a]	0.0009
Prepregnancy BMI	22.5 ± 3.4[b]	23.5 ± 3.8[a]	24.9 ± 4.0[a]	0.0009
Parity (%) 0/1/>1	42.3/50/7.7	45.6/47.5/7.0	40/60	0.94
Family Hx (%)	52.3	64.0	74.1	0.02

* Significantly different among three groups at P<0.05. *** at P<0.001.

[a,b]Means in the same row with different superscripts were significantly different by Tukey test at P<0.05.

Glucose homeostasis during pregnancy



** Significantly different among three groups at P<0.01. *** at P<0.001.
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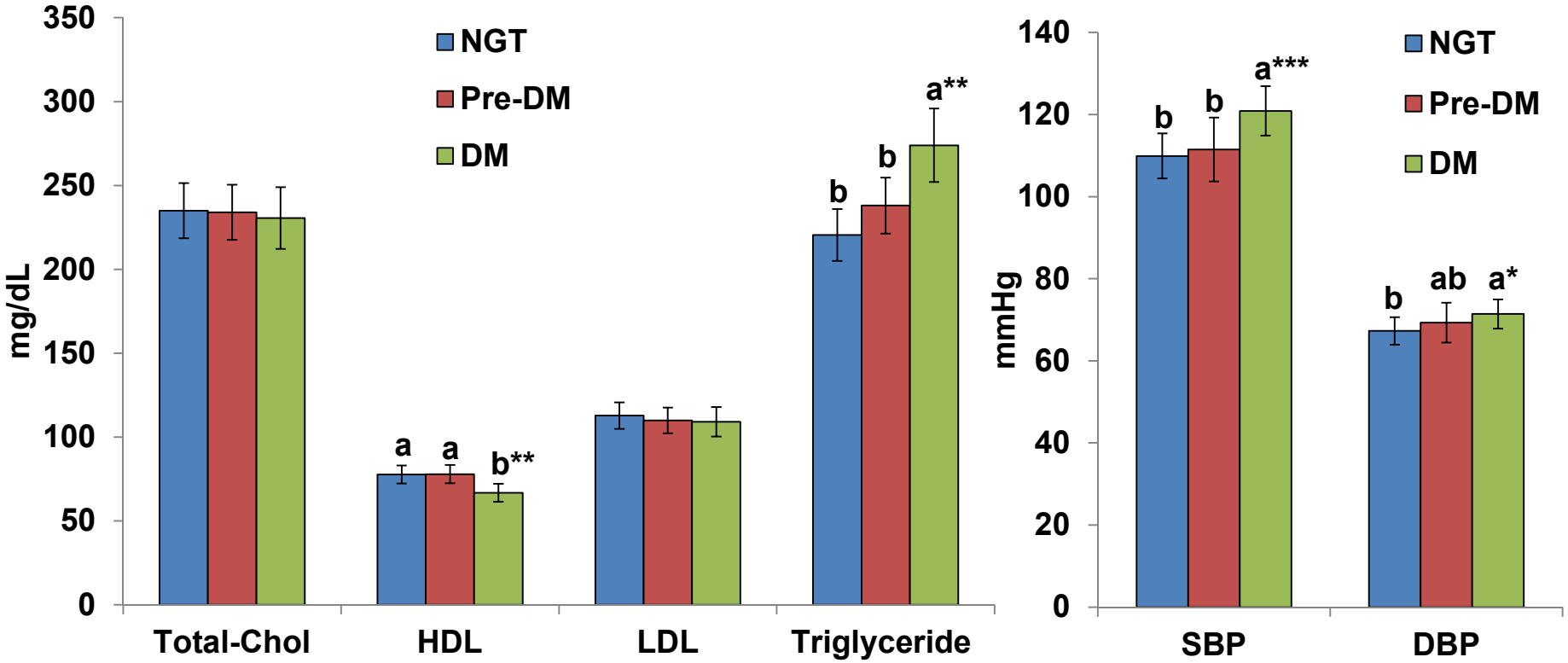
Lipid profiles during pregnancy



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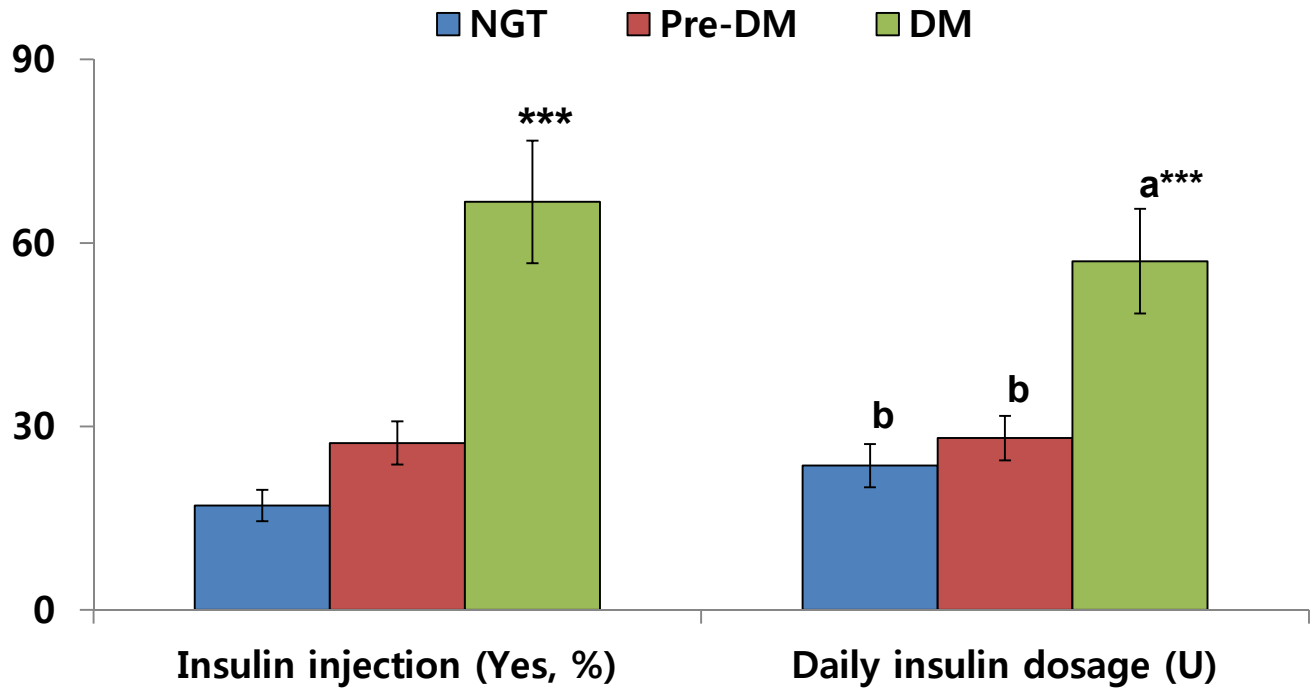
Insulin therapy during pregnancy



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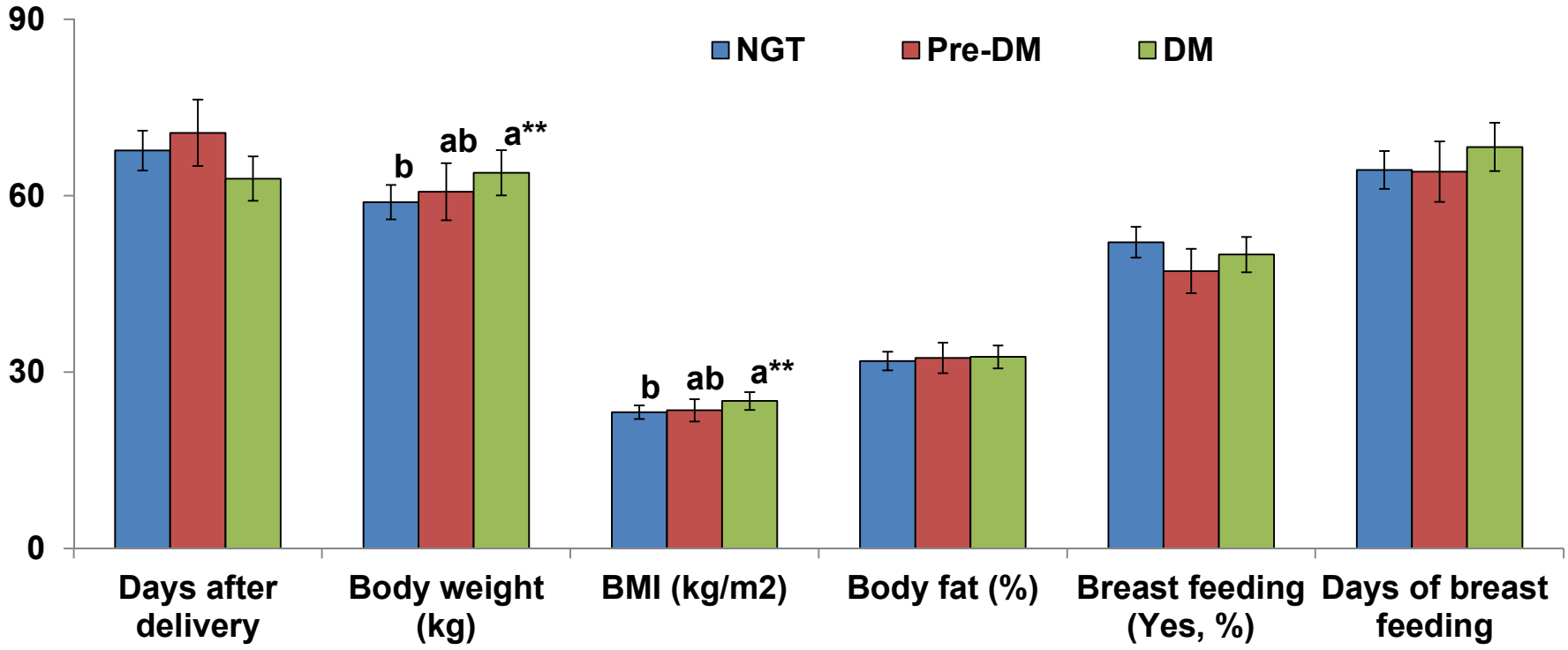
Pregnancy outcome

	NGT (n=193)	Pre-DM (n=161)	DM (n=27)
Days of gestation	271.9±11.2	270.3±10.4	266.3±14.3
Baby weight (g)	3264±469	3250±467	3259±6608
APGAR score	9.0±0.6	8.9±0.6	8.8±0.7
Body weight at Delivery (kg)	67.3±8.8[a]	69.0±9.7[ab]	72.9±11.4[b**]
BMI at delivery	26.5±3.2[b]	27.1±3.6[ab]	28.6±4.4[a**]
Weight gain during pregnancy (kg)	10.1±4.1	9.1±4.9	8.6±4.6

Anthropometric measurements and breast feeding at 6-12 wks of delivery



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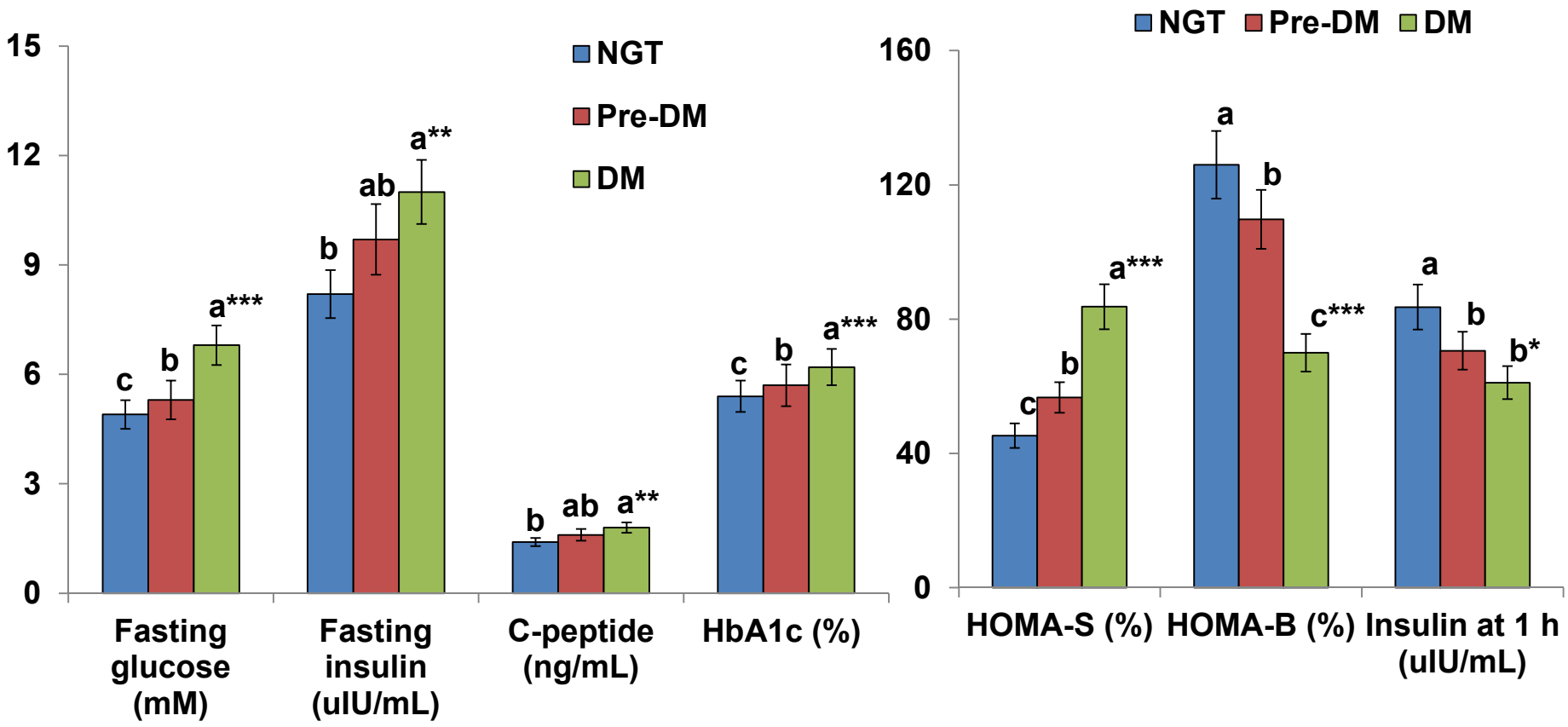
Glucose homeostasis at 6-12 wk postpartum



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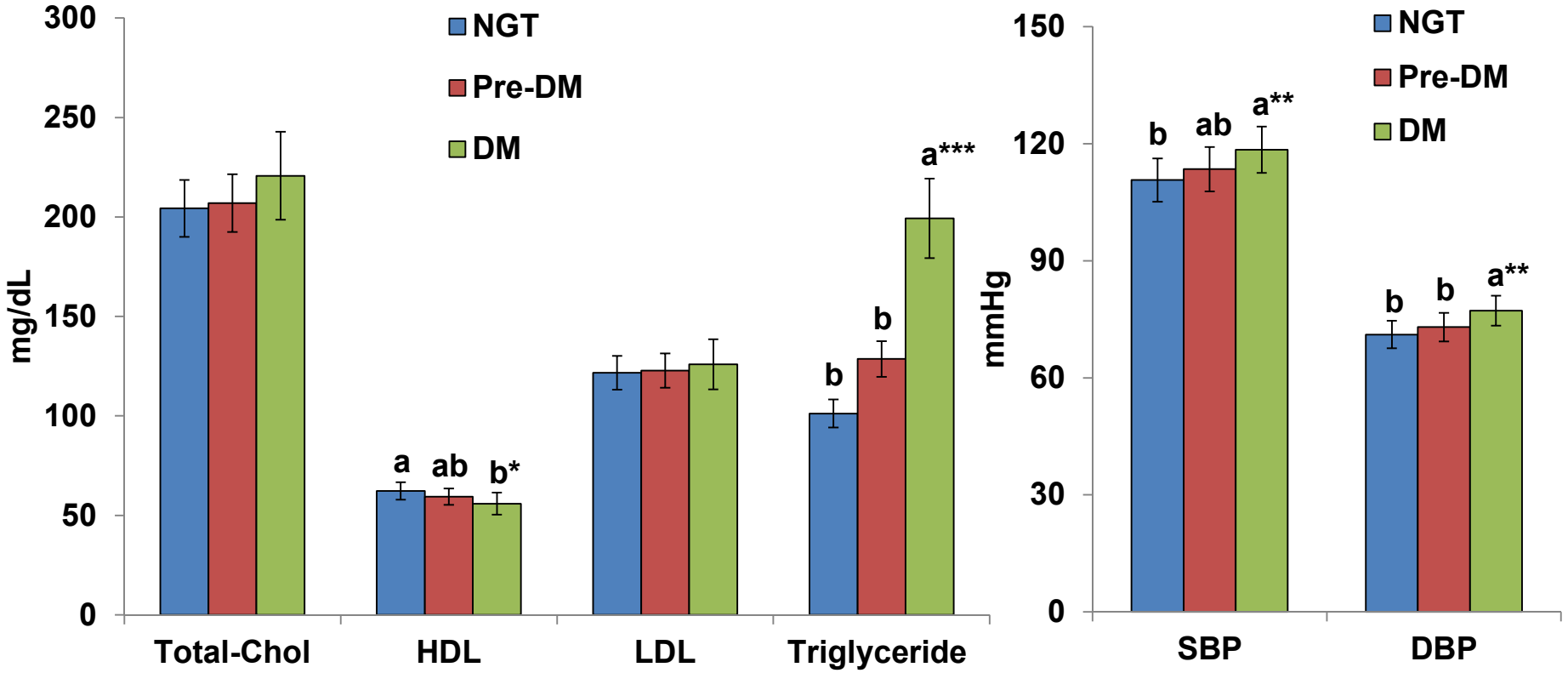
Lipid profiles at 6-12 wk postpartum



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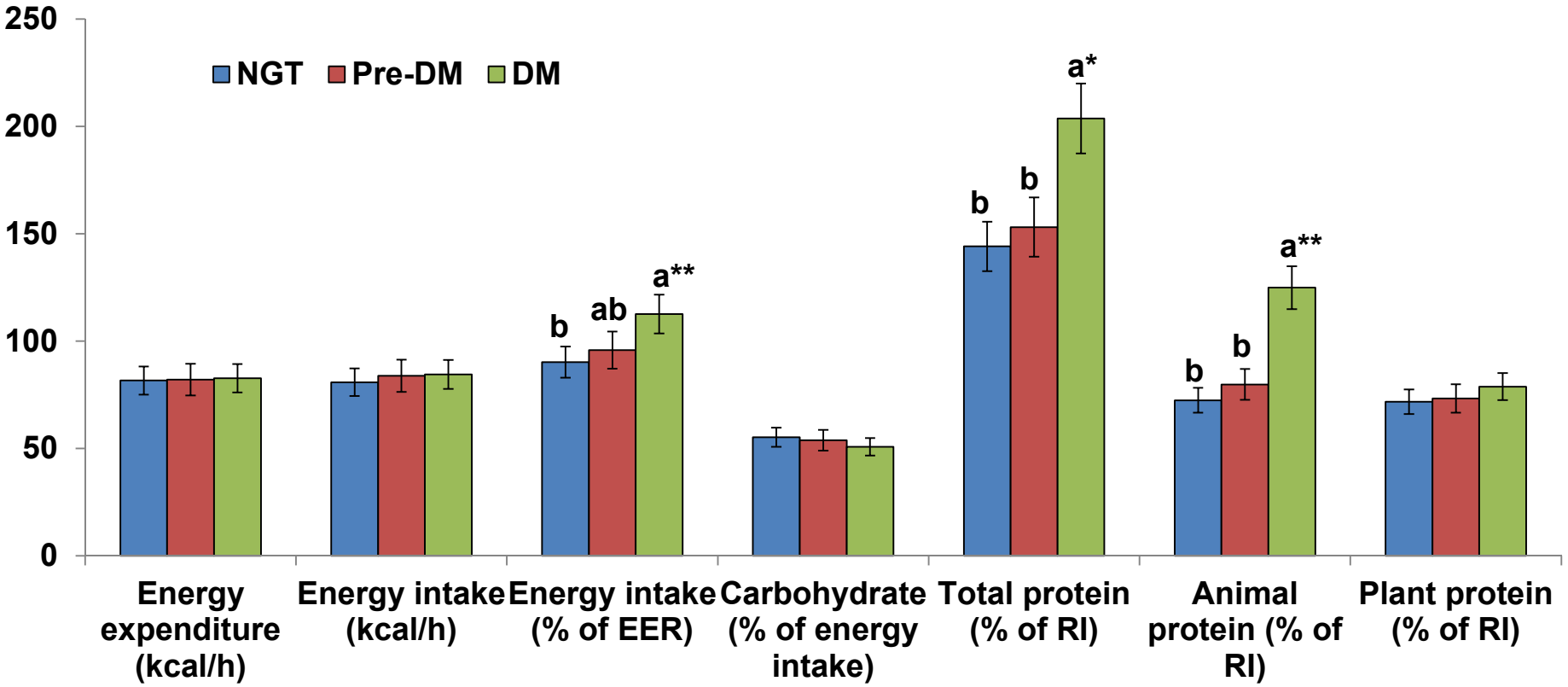
Postpartum energy intake and expenditure and nutrient intake



EER, Estimated energy requirement; RI, Recommended intake

* Significantly different among three groups at P<0.05. ** P<0.01.

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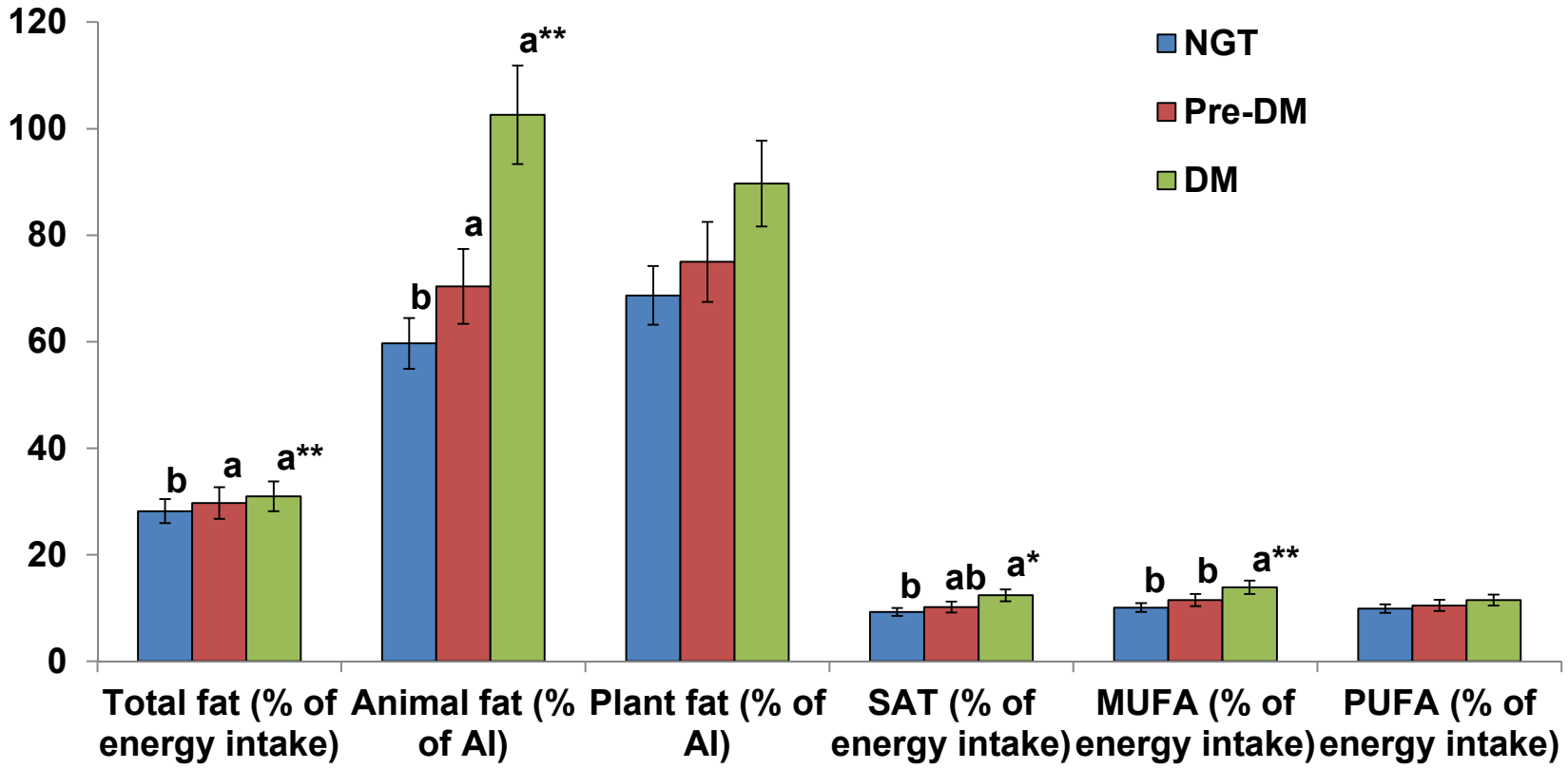
Postpartum dietary fat intake



AI, Adequate intake

* Significantly different among three groups at P<0.05. ** P<0.01.

[a,b]Means in the same row with different superscripts were significantly different by Tukey test at P<0.05.

Antepartum factors predicting postpartum dysglycemia using dependent variable of log AUC of glucose at 6-12 wks after delivery

Independent variables (R^2=0.14)	Beta	P value
BMI	0.054	0.03
Family history of diabetes	0.38	0.05
HOMA-B at late pregnancy	-0.003	0.004
Insulin dosage during late pregnancy	1.1	<0.0001

AUC : area under the curve of glucose during oral glucose tolerance test at 6-12 wks after delivery

Postpartum factors predicting postpartum dysglycemia using dependent variable of log AUC of glucose at 6-12 wks after delivery

Independent variables (R^2=0.43)	Beta	P value
BMI at postpartum	0.059	0.04
HbA_{1c} at postpartum	1.2	<0.0001
Plasma triglyceride at postpartum	0.003	0.0083
HOMA-B at postpartum	-0.007	0.0001
Energy intake as the percent of estimated energy requirement	0.009	0.05
Breast feeding	-0.016	0.25

Summary

- **The incidence of postpartum pre-diabetes and diabetes at 6-12 week follow-up in Korean women with GDM was 44.8 and 5.2 %, respectively.**

- **Animal protein and fat intake was higher in the pre-diabetes and diabetes groups than the NGT group while breast feeding did not alter the risk for the development of postpartum diabetes.**

- **Antepartum modifiable risk factors for developing type 2 diabetes at early postpartum included higher BMI, lower β-cell function, insulin dosage during late pregnancy and the non-modifiable risk factor of family history of diabetes (R^2=0.14).**

- **Post-partum risk factors included higher BMI, serum triglycerides, HbA_{1c} and energy intake, and lower insulin secretion capacity (R^2=0.43).**

Conclusion

- **Simple dietary and lifestyle modifications such as maintaining ideal body weight and avoiding excessive consumption of animal foods, energy and fat might prevent or delay the onset of type 2 diabetes in women with a history of gestational diabetes mellitus**

Postpartum testing and follow-up

Table 2—*Metabolic assessments recommended after GDM*

Time	Test	Purpose
Post-delivery (1–3 days)	Fasting or random plasma glucose	Detect persistent, overt diabetes
Early postpartum (around the time of postpartum visit)	75-g 2-h OGTT	Postpartum classification of glucose metabolism*
1 year postpartum	75-g 2-h OGTT	Assess glucose metabolism
Annually	Fasting plasma glucose	Assess glucose metabolism
Tri-annually	75-g 2-h OGTT	Assess glucose metabolism
Prepregnancy	75-g 2-h OGTT	Classify glucose metabolism

Summary and Recommendations of the Fifth International Workshop-Conference on Gestational Diabetes Mellitus, Diabetes Care 30 (Suppl.2), 2007

Prevention of T2DM in women with GDM

- In women with a history of GDM, Metformin and intensive lifestyle: ~50% reduction in the risk of diabetes

- Women with a history of GDM found to have prediabetes should receive lifestyle interventions or metformin to prevent diabetes

ADA: Standards of Medical Care in Diabetes—2012. Diabetes Care 35:S11-S63

Future directions

- Risk and timeline for progression to diabetes

- Appropriate preventive strategies

  - Optimal timing and cost-effectiveness of diabetes prevention interventions

  - Effective ways to deliver preventive interventions

Take home messages

- Women with GDM should undergo repeat glucose testing postpartum and receive appropriate counseling on their risk of future diabetes and of need for life style changes and weight management.

- Clinicians have a great opportunity to improve the lives of women with history of GDM and their families by applying recent knowledge regarding the early detection, prevention, and management of hyperglycemia and other cardiovascular risk factors.

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