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CODEN [USA]: IAJPBB

ISSN: 2349-7750

# INDO AMERICAN JOURNAL OF PHARMACEUTICAL SCIENCES

http://doi.org/10.5281/zenodo.3240063

Available online at: <u>http://www.iajps.com</u>

**Research Article** 

# TYPE 2 DIABETES MELLITUS AFTER GESTATIONAL DIABESTES: A META ANALYSIS STUDY

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Article Received: April 2019 Accepted: May 2019 Published: June 2019

### Abstract:

Increased risk of developing type 2 diabetes in women with who had gestational diabetes. A comprehensive systematic review and meta-analysis to assess the strength of association between these conditions and the effect of factors that might modify the risk. It is identified that cohort studies in which women who had developed type 2 diabetes after gestational diabetes were followed up from Embase and Medline. 20 studies were included in study that met our inclusion criteria. Included studies with 675 455 women and 10 859 type 2 diabetic events. Calculated and pooled unadjusted relative risks (RRs) with 95% CIs for each study using a random-effects model. Number of cases of type 2 diabetes, ethnic origin, and duration of follow-up, maternal age, body-mass index, and diagnostic criteria were analyzed as subgroup. In conclusion, gestational diabetes had an increased risk of developing type 2 diabetes AS compared with those who had a normoglycaemic pregnancy (RR 7.43, 95% CI 4.79–11.51). Although the largest study (659 164 women; 9502 cases of type 2 diabetes) had the largest RR (12.6, 95% CI 12.15–13.19), RRs were generally consistent among the subgroups assessed.

Key Words: Gestational Diabetes, Type 2 Diabetes, Diabetes Mellitus.

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Please cite this article in press Malaika Rehmani et al., **Type 2 Diabetes Mellitus After Gestational Diabestes: A** Meta Analysis Study., Indo Am. J. P. Sci, 2019; 06(06).

### **INTRODUCTION:**

Gestational diabetes mellitus (GDM), or impaired glucose intolerance first diagnosed during pregnancy [1], affects 14% of pregnancies, or 135,000 women a year in the U.S., and is a risk factor for type 2 diabetes in the mother [2]. It is not clear that how much of the variation is reported by changing in ethnicity, length of follow-up, selection criteria, and tests for GDM and type 2 diabetes [3-5]. Screening protocols for type 2 diabetes could be affected by the basic understanding in risk differences in women with a history of GDM.

Gestational diabetes mellitus is defined as glucose intolerance that is first detected during pregnancy. Shortly after delivery, glucose homoeostasis is restored to non-pregnancy levels, but affected women remain at high risk of developing type 2 diabetes mellitus in the future.<sup>6, 7</sup> For any population and ethnic group, the risk of gestational diabetes indicates the underlying frequency of type 2 diabetes.<sup>8</sup> The incidences of gestational diabetes and type 2 diabetes are rising throughout the world, with huge health-care and economic costs. [9<sup>9, 10</sup>

Women who have had gestational diabetes are advised to have their glucose tolerance assessed 6 weeks after delivery.<sup>11</sup> However, low rates of attendance at the 6-week follow-up, [12] suggest that health-care professionals, women with gestational diabetes, or both, do not realize the importance of this disorder as an early warning sign of the susceptibility to develop type 2 diabetes in the future; therefore an opportunity to promote health and prevent disease is missed. Moreover, no consensus exists on how and whether mothers should continue to be monitored after this period. The association between gestational diabetes and type 2 diabetes mellitus has implications for the elucidation of the causes of these disorders, and for the prediction and possible prevention or delay of the development of type 2 diabetes in women.

### **METHOD:**

Electronic databases were used .search of Embase from 1974 to 2018, and Medline search term combinations were "gestational diabetes", "diabetic pregnancy", "diabetes mellitus", "type 2 diabetes mellitus", "NIDDM", and "non-insulin dependent diabetes mellitus". All reference lists were hand searched manually for additional eligible studies. We identified retrospective and prospective cohort studies, in which pregnant women of any parity or ethnic origin were identified as having gestational diabetes (exposed group) and normoglycaemic pregnancies (control group). The outcome studied was the development of type 2 diabetes at least 6 weeks after the end of the index pregnancy, and was defined with an oral glucose tolerance test or fasting plasma glucose concentration, or both, Cohort studies of women with diabetes mellitus before the index pregnancy were excluded. If there was more than one report relating to the same cohort, the report with the information most relevant to our analysis was included. We used RevMan (version 5) to calculate unadjusted summary relative risks (RRs) with 95% CIs, using a random-effects model for all analyses We investigated potential sources of identified heterogeneity among studies by stratification according to the number of cases of type 2 diabetes (500); ethnic origin (white, non-white, and mixed race populations); average follow-up (30 kg/m<sup>2</sup>); study design (prospective and retrospective); and variation in criteria used in each study to diagnose gestational diabetes and type 2 diabetes.

### **RESULTS:**

Figure 1 shows the study selection process (reasons for exclusion are listed in web appendix pp 1-13). 48 of 68 full-text reports meeting all the inclusion criteria were subsequently excluded because of the absence of an appropriate control or reference population. The 20 remaining studies (table), contributed 675 455 women with type 2 diabetes to the meta-analysis, and 31 867 of these had previous pregnancies affected by gestational diabetes with a total of 10 859 incident cases of type 2 diabetes. Figure 2 shows the overall RR of women developing type 2 diabetes after a pregnancy complicated by gestational diabetes with evidence of heterogeneity in the risk estimate. Generally, small studies had large effect estimates (fi gure 3), but the largest study18 included in the meta-analysis had the largest effect estimate (fi gure 2). Figure 4 shows the potential sources of heterogeneity by study characteristics, participant characteristics, and diagnostic criteria for gestational diabetes and type 2 diabetes. Effect estimates were broadly consistent in all the subgroups analyzed (figure 4B: figure 4C). There was some heterogeneity in effect estimates when studies were grouped according to the number of cases of type 2 diabetes (500; figure 4A). Heterogeneity was reduced by exclusion of the largest study ( $\chi^2=1.48$ , df=1,  $p=0.22, I^2=32.2\%$ ).

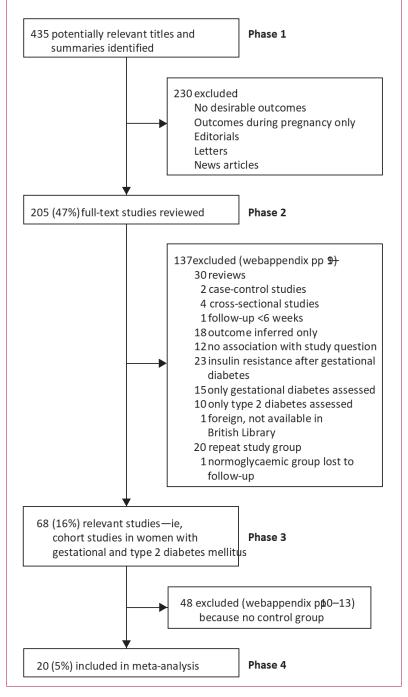


Figure 1Study selection process

	Country	T2DM/GDM	T2DM/no GDM		Relative risk (95% CI)
Feig et al, <sup>18</sup> 1995–2002	Canada	2874/21823	6628/637341		12.66 (12.15-13.19)
Lee H et al, <sup>15</sup> 1995–97	Korea	71/620	22/868		4.52 (2.83-7.21)
Madarasz et al, <sup>21</sup> 1995	Hungary	21/68	0/39	— <b>—</b> →	24.93 (1.55-400.64)
Gunderson et al, <sup>22</sup> 1985–206	USA	43/166	150/2242	-	3.87 (2.87-5.22)
Vambergue et al, <sup>23</sup> 1992	France	53/295	1/111	<b>-</b> >	19.94 (2.79–142.47)
Lee A et al, <sup>24</sup> 1971–2003	Australia	405/5470	16/783		3.62 (2.21-5.93)
Ferraz et al <sup>17</sup> *	Brazil	6/70	7/108	<b></b>	1.32 (0.46-3.78)
Krishnaveni et al, <sup>25</sup> 1997–98	India	13/35	8/489		22.70 (10.09-51.08)
Morimitsu et al, <sup>26</sup> 1999–2001	Brazil	7/23	0/11		7.50 (0.47-120.11)
Järvelä et al,⁵ 1984–94	Finland	23/435	0/435		47.00 (2.86-771.65)
Albareda et al, <sup>27</sup> 1966–93	Spain	44/696	0/70		9.07 (0.56-146.25)
Åberg et al, <sup>28</sup> 1991–99	Sweden	21/229	1/61		5.59 (0.77-40.66)
Linné et al, <sup>16</sup> 1964–65	Sweden	10/28	0/52	· · · · · · · · · · · · · · · · · · ·	38.38 (2.33-631.74)
Bian et al, <sup>29</sup> 1964–65	China	15/45	1/39		13.00 (1.80-93.93)
Ko et al, <sup>30</sup> 1988–95	China	105/801	7/431	<b></b>	8.07 (3.79-17.19)
Osei et al, <sup>31</sup> 1990–91	USA	10/15	0/35	<b>-</b> ►►	47.25 (2.95-757.28)
Damm et al, <sup>32</sup> 1978–85	Denmark	33/241	0/57	• • • • •	16.06 (1.00-258.06)
Benjamin et al, <sup>33</sup> 1961–88	New Mexico	14/47	3/47		4.67 (1.43-15.21)
0'Sullivan, <sup>34</sup> 1954–60 and 1962–70	USA	224/615	18/328		6.64 (4.19-10.52)
Persson et al, <sup>35</sup> 1961–84	Sweden	5/145	0/41		3.16 (0.18–55.76)
		3997/31867	6862/643588		7.43 (4.79-11.51)

Figure 2: Risk of type 2 diabetes mellitus (T2DM) after gestational diabetes mellitus (GDM)

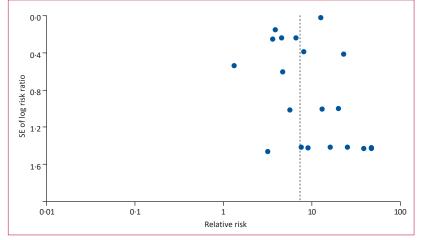


Figure 3Funnel plot of 20 cohort studies included in meta-analysis

	Total number of cases of T2DM		Relative risk (99% CI)	I² (%; 99% CI)	τ2	χ²test of heterogeneity (p value)
A						
Ethnic origin				0 (0-95)	0	0.78 on 2 df (0.68)
White (7 studies)	158		12.76 (2.31-70.63)	0 (0-80)	0	3.31 on 6 df (0.77)
Non-white (6 studies)	265		7.45 (2.43-22.83)	78 (38-92)	0.76	22.97 on 5 df (0.0003)
Mixed (7 studies)	10436		6.36 (2.06-19.61)	93 (87–97)	0.55	92.20 on 6 df (<0.0001)
Follow-up time				60 (N/A)	0.14	2.49 on 1 df (0.11)
<5 years (8 studies)	698	<b>_</b>	4.69 (2.84-7.75)	0 (0-77)	0	4.66 on 7 df (0.70)
≥5 years (12 studies)	10161		9.34 (3.42-25.54)	88 (77-93)	0.53	88·10 on 11 df (<0·0001)
Study design				0 (N/A)	0	0.62 on 1 df (0.43)
Prospective (9 studies)	779		6.07 (2.68-13.74)	71 (29-88)	0.28	27.64 on 8 df (0.0005)
Retrospective (11 studies)	10080		9.29 (3.02-28.60)	68 (27-86)	0.46	31·30 on 10 df (0·0005)
Number of incident cases				88 (54-97)	0-05	16-78 on 2 df (0-0002)
<100 (15 case studies)	389		8.71 (3.00-25.31)	52 (0-72)	0.58	29.37 on 14 df (0.009)
100–500 (4 studies)	309 968		4.88 (2.65-8.97)	55 (0-90)	0.58	6.74 on 3 df (0.009)
>500 (1 study)	9502		12.66 (11.79–13.60)	55 (0-90) N/A	0.07 N/A	N/A
2500 (13t0dy)	5302	-	12:00 (11/9-13:00)	1970	17/2	0/0
В						
Maternal age				0 (0-92)	0	0·25 on 3 df (0·97)
<30 years (5 studies)	9602	<b>_</b>	6.67 (1.08-41.16)	81 (14-94)	1.02	20.65 on 4 df (0.0004)
≥30 years (9 studies)	739		6.14 (2.66-14.15)	33 (0-76)	0.14	11.93 on 8 df (0.15)
Age range reported only (4 studies)	478	<b>_</b>	7.40 (2.03-26.94)	83 (14-95)	0.41	17.50 on 3 df (0.0006)
Not similar* (2 studies)	40 -		10.97 (0.37-325.68)	0 (N/A)	0	0·14 on 1 df (0·70)
BMI at index pregnancy				42 (0-88)	0.10	3.46 on 2 df (0.18)
<25 kg/m <sup>2</sup> (4 studies)	205	<b>_</b>	8-92 (2-83-28-12)	0 (0-92)	0	0.38 on 3 df (0.94)
25-30 kg/m <sup>2</sup> (1 study)	428		3.70 (1.59-8.58)	0 (N/A)	0	0.26 on 1 df (0.61)
Not recorded (15 studies)	10226		7.66 (3.12–18.79)	88 (79–93)	0.52	109·78 on 13 df (<0·0001)
BMI at follow-up				0 (0-92)	0	0-20 on 3 df (0-98)
<25 kg/m <sup>2</sup> (5 studies)	424	— <b>—</b> —	6.66 (2.29-19.40)	78 (29-93)	0.32	17·98 on 4 df (0·001)
25-30 kg/m <sup>2</sup> (3 studies)	105	$\rightarrow$	8.94 0.58-138.54)	64 (0-90)	1.98	11·20 on 4 df (0·02)
≥30 kg/m² (2 studies)	27 —	<b>→</b>	10.42 (0.25-433.97)	56 (N/A)	1-49	2.26 on 1 df (0.13)
Not recorded (10 studies)	10303		8.10 (2.82-23.25)	79 (49–91)	0.36	33·33 on 7 df (<0·0001)
c						
GDM criteria				0 (0-80)	0	5.27 on 6 df (0.51)
WHO (3 studies)	39		3.28 (0.17-62.56)	48 (0-90)	1.16	3.87 on 2 df (0.14)
NDDG (4 studies)	163	<b>_</b>	6.77 (1.61-28.47)	20 (0-93)	0.20	3.75 on 3 df (0.29)
Countrywide guidelines (3 studies)	451		6.54 (0.61-69.89)	40 (0-87)	0.70	3.33 on 2 df (0.19)
Carpenter and Coustan (2 studies)	75		22.27 (6.10-81.25)	0 (N/A)	0	0.01 on 1 df (0.90)
EASD (1 study)	22		5.59 (0.18-172.63)	N/A	N/A	N/A
Local (5 studies)	414		7.03 (3.73-13.25)	0 (0-87)	0	2.40 on 4 df (0.66)
Other† (2 studies)	9695		7.07 (0.95–52.45)	98 (N/A)	0.69	58-89 on 1 df (<0-00001)
T2DM criteria				22 (0-75)	0.05	5·14 on 4 df (0·27)
WHO (11 studies)	950	<b>●</b>	6.60 (2.58–16.89)	61 (7-83)	0.37	25.45 on 10 df (0.005)
NDDG (2 studies)	27		10.42 (0.25-433.97)	56 (N/A)	1-49	2.26 on 1 df (0.13)
ADA (3 studies)	254		5.46 (1.12-26.69)	29 (0–96)	0.28	2.80 on 2 df (0.25)
Local (2 studies)	103 -	<b>→</b>	8.28 (0.32-216.45)	54 (N/A)	1.24	2·18 on 1 df (0·14)
Other† (2 studies)	9525		12.66 (11.79–13.60)	0 (N/A)	0	0·84 on 1 df (0·36)
	· · · · ·					
	0.01 0.1	1 10 100	)			

Figure 4: Risk of type 2 diabetes mellitus (T2DM) grouped by study characteristics (A), participant characteristics (B), and diagnostic criteria (C)

	Study type, year, country	Ethni c origin	maternal	GDM criteria	Total women studied (degree of matching GDM/ non-GDM)	Mean follow- up ( SD or 95% CI )	Defi nition of T2DM
Feig et al <sup>18</sup>	Retrospectiv e cohort, 2008, Canada	Mixed	29.3 (5.5)	Canadian Institute for Health Information (discharge summary) <sup>36</sup>	659 164	5·2 years <sup>i</sup>	Ontario Diabetes Database <sup>ii,37</sup>
Lee H et al <sup>15</sup>	Prospective cohort <sup>iii</sup> , 2008, Korea	Non- white	33.6 (4.8)	National Diabetes Data Group, 1979 <sup>iv,38</sup>	1736 <sup>v</sup> (248 IGT)	2·1 years <sup>i</sup>	Local <sup>vi</sup>
Madarász et al <sup>21</sup>	Retrospectiv e cohort <sup>iii</sup> , 2008, Hungary	White	33·1/30·0 (5·9)	WHO, 1999 <sup>vii,39</sup>	107	3.6 years (GDM; 0.8)/ 8.1 years (non- GDM; 5.1)	WHO, 1999 <sup>viii,40</sup>
Gunderson et al <sup>22</sup>	Prospective cohort, 2007, USA	Mixed	Matched range 18– 30	Obstetric laboratory reports	2408	Total 20 year follow- up (72% followed for entire time)	American Diabetes Association, 1997 <sup>ix/</sup> diabete s medication/sel f report
Vambergue et al <sup>23</sup>	Prospective cohort, 2007, France	Mixed	$27 \cdot 0$ (5 \cdot 2)/28 \cdot 8 (5 \cdot 8)	Carpenter and Coustan <sup>x,41</sup>	581 <sup>xi,xii</sup> (175 AGT)	6.75 years (0.8)	American Diabetes Association, 1997 <sup>ix</sup>
Lee A et al <sup>24</sup>	Retrospectiv e cohort, 2007, Australia	Mixed	30·7 (5·1)/30·5 (4·6)	Australian Diabetes <sup>xiii,42</sup> (pregnancy guidelines)	6253 <sup>xiv</sup>	2·2 years (GDM), i 8·6 years (non- GDM) <sup>i</sup>	WHO, 1998 <sup>viii,40</sup>
Ferraz et al <sup>17</sup>	Prospective cohort, 2007, Brazil	Non- white	26.9/25.1	WHO, 1999 <sup>xv,43</sup>	178xvi	$6 \cdot 2$ years $(0 \cdot 8)$	WHO, 1999 <sup>viii,40</sup>
Krishnaven i et al <sup>25</sup>	Prospective cohort, 2007, India	Non- white	Matched age range	Carpenter and Coustan <sup>x,41</sup>	524	5 years	WHO, 1999 <sup>viii,40</sup>

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Morimitsu et al <sup>26</sup>	Prospective cohort, 2007, Brazil	Mixed	32/27 (7)	American Diabetes Association, 1997 <sup>xvii,14</sup>	34xviii	16–24 weeks	American Diabetes Association, 1997 <sup>ix</sup>
Järvelä et al <sup>5</sup>	Retrospectiv e cohort <sup>iii</sup> , 2006, Finland	White	31.6 (17.7– 46.5)/31.3 (18.8– 46.0)	Finnish Diabetes Association <sup>xix,44</sup>	870v,xii,xiv	5.7 years (GDM; 1.0– 11.6) 6.1 (non- GDM; 1.5– 13.1)	Medication for T2DM linked to database <sup>xx,45</sup>
Albareda et al <sup>27</sup>	Prospective cohort, 2003, Spain	White	30.7/30.4	Second and third GDM workshop conference <sup>xxi,46,4</sup> 7	766xiv	6·16 years (0·05– 13·73)	WHO, 1998 <sup>viii,40</sup>
Åberg et al <sup>28</sup>	Retrospectiv e cohort, 2002, Sweden	White	Matched range 20– 45	European Association for Study of Diabetes <sup>xxii,48</sup>	290	1 year	WHO, 1985 <sup>xxiii</sup>
Linné et al <sup>16</sup>	Retrospectiv e cohort <sup>iii</sup> , 2002, Sweden	White	32.6/30.6	Local <sup>xxiv</sup>	80v,xvi,xxv	15 years	Local <sup>xxvi</sup>
Bian et al <sup>29</sup>	Retrospectiv e cohort, 2000, China	Non- white	29/29 (23– 40)	National Diabetes Data Group, 1979 <sup>iv</sup>	84v,xiv,xviii,xxvi i	5–11 years	WHO, 1985 <sup>xxiii</sup>
Ko et al <sup>30</sup>	Prospective cohort, 1999, China	Non- white	34·0 (4·1)/34·4 (6·4)	Localxxviii	1232 <sup>v</sup>	6 weeks	WHO, 1985 <sup>xxiii</sup>
Osei et al <sup>31</sup>	Retrospectiv e cohort, 1998, USA	Non- white	$31 \cdot 3$ (2·0)/36·0 (0·9)	National Diabetes Data Group, 1979 <sup>iv</sup>	65xxix	7 years	National Diabetes Data Group, 1979 <sup>xxx,49</sup>
Damm et al <sup>32</sup>	Retrospectiv e cohort, 1994, Denmark	White	30.1/26.7	Local <sup>xxxi</sup>	298xiv	7.5 years <sup>i</sup>	WHO, 1985 <sup>xxiii</sup>
Benjamin et al <sup>33</sup>		Mixed	27.2/26.5	Localxxxii,50	94v,xii,xvi,xxxiii,51	4.8 years (GDM)/ 5.5 years (non- GDM)	National Diabetes Data Group, 1979 <sup>xxx,49</sup>
O'Sullivan <sup>3</sup>	Prospective cohort, 1991, USA	Mixed		Localxxxii	943	22–28 years	WHO, 1985 <sup>xxiii</sup>

### **DISCUSSION:**

Women who have had gestational diabetes have at least a seven-fold increased risk of developing type 2 diabetes mellitus in the future compared with those who have had a normoglycaemic pregnancy. The strength of the association between gestational diabetes and type 2 diabetes, and the knowledge that many of the risk factors are the same suggest that the two disorders might have an overlapping cause. Results of candidate gene studies, giving support to this hypothesis, show that frequency of some alleles associated with the increased risk of development of type 2 diabetes were increased in women who had gestational diabetes. Irrespective of the precise biological link between these two disorders, the development of gestational diabetes might help to identify women at high risk of developing type 2 diabetes.

Although women who have had gestational diabetes are recommended to have a glucose tolerance test at 6 weeks postpartum, most do not attend.11 The increased risk of type 2 diabetes reported in this meta-analysis might help to motivate mothers to screening programs, and health-care attend professionals to increase uptake to these programs or perhaps suggest the best time for reassessment. Since the risk of type 2 diabetes seems to be maintained for several years, consideration of whether any form of continuous assessment would lead to health gains is important. Women who have had gestational diabetes also have increased lipid concentrations and blood pressure, and type 2 diabetes is estimated to confer an equivalent risk of ageing 15 years. Early identification and treatment of these factors could also help to reduce premature cardiovascular and renal diseases in this group of individuals.

Suggesting that much of the heterogeneity was unexplained. The effect estimates reported in studies in which different criteria were used for the diagnosis of gestational diabetes mellitus and type 2 diabetes mellitus were similar. The number of cases of type 2 diabetes included in our analysis contributed to the heterogeneity, which was reduced by exclusion of the largest study. However, this study was of high quality and resulted in an effect size that was larger, instead of smaller, than the estimates from small studies. Although we did not identify the main sources of heterogeneity of effect size, a meta-analysis of summary data from reported studies has little capacity to do so.

### **CONCLUSION:**

Magnitude and timing of the risk of type 2 diabetes after gestational diabetes have increased awareness among patients and clinicians could provide an opportunity to test and use dietary, lifestyle, and pharmacological interventions that might prevent or delay the onset of type 2 diabetes in affected women.

### **REFERENCE:**

- American Diabetes Association: Gestational diabetes mellitus. Diabetes Care 23 (Suppl. 1):S77–S79, 2000
- 2. Jovanovic L, Pettitt D: Gestational diabetes mellitus. JAMA 286:2516–2518, 2001
- Henry O, Beischer N: Long-term implications of gestational diabetes for the mother. Baillieres Clin Obstet Gynaecol 5:461–483, 1991
- 4. O'Sullivan J: Diabetes mellitus after GDM. Diabetes 29:131–135, 1991
- Coustan D: Gestational diabetes. In Diabetes in America. 2nd ed. Harris MI, Cowie CC, Stern MP, Boyko EJ, Reiber GE, Bennett PH, Eds., Washington, DC, U.S. Govt. Printing Office, 1995 (NIH publ. no. 95-1468), p. 703–717
- 6. Kim C, Newton KM, Knopp RH. Gestational diabetes and the incidence of type 2 diabetes. Diabetes Care 2002; 25: 1862–68.
- Järvelä IY, Juutinen J, Koskela P, et al. Gestational diabetes identifi es women at risk for permanent type 1 and type 2 diabetes in fertile age. Predictive role of auto-antibodies. Diabetes Care 2006; 29: 607–12.
- 8. Hunt KJ, Schuller KL. The increasing prevalence of diabetes in pregnancy. Obstet Gynecol Clin North Am 2007; 34: 173–99.
- Lipscombe LL, Hux JE. Trends in diabetes prevalence, incidence, and mortality in Ontario, Canada 1995–2005: a population-based study. Lancet 2007; 369: 750–56.
- 10. American Diabetes Association. Economic costs of diabetes in the US in 2002. Diabetes Care

2003; 26: 917–32.

- 11. Kim C, McEwen LN, Piette JD, et al. Risk perception for diabetes among women with histories of gestational diabetes mellitus. Diabetes Care 2007; 30: 2281–86.
- 12. Kim C, Tabaei BP, Burke R, et al. Missed opportunities for type 2 diabetes mellitus screening among women with a history of gestational diabetes mellitus. Am J Public Health 2006; 96: 1643–48.