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CLINICAL STUDY

Gestational diabetes mellitus among Norwegian women with polycystic ovary syndrome: prevalence and risk factors according to the WHO and the modified IADPSG criteria

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Abstract

Objective: The consequences of the recently proposed International Association of Diabetes in Pregnancy Study Group (IADPSG) criteria for gestational diabetes mellitus (GDM) in women with polycystic ovary syndrome (PCOS) are not known. We compared the prevalence rates and risk factors for GDM in PCOS women according to both the WHO and the modified IADPSG criteria.
Design: *Post hoc* analyses from a randomized, multicenter study were used.
Methods: Fasting and 2-h plasma glucose levels were measured using a 75 g oral glucose tolerance test. GDM was diagnosed according to both the WHO and the modified IADPSG criteria.
Results: The prevalence rates of GDM according to the WHO and the modified IADPSG criteria were 9.2 and 15.0% at week 12, 18.7 and 18.7% at week 19, and 25.6 and 24.2% at week 32. Shorter stature and increased insulin levels were correlated with WHO-GDM, but not with modified IADPSG-GDM at weeks 12 and 19. Less weight gain in pregnancy predicted GDM according to both sets of criteria. GDM diagnosis was correlated with less maternal weight loss the first year *post-partum*.
Conclusions: No difference was found in the prevalence of GDM between the two sets of criteria used. Less weight gain in pregnancy was associated with GDM, independent of the diagnostic criteria used. Reduced weight loss the first year *post-partum* in women with GDM raises the question of whether GDM diagnosis *per se* or the fact that these women lose less weight after pregnancy predicts later diabetes mellitus.

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Introduction

The incidence of diabetes mellitus is increasing worldwide. This is also the case for diabetes in pregnancy – gestational diabetes mellitus (GDM) (1, 2). The association between GDM and adverse pregnancy outcomes is well documented (3, 4, 5, 6). The linear association between increasing maternal blood glucose levels and adverse pregnancy outcomes has raised the question of which criteria should be used for GDM diagnosis (7). In some countries, the WHO criteria have been substituted by the stricter International Association for Diabetes in Pregnancy Study Group (IADPSG) criteria (8). The IADPSG criteria increases the prevalence of GDM (9).

Polycystic ovary syndrome (PCOS) is the commonest endocrine disorder among women of fertile age, affecting ~10–15% of the fertile female population based on the Rotterdam criteria. The NIH criteria give a somewhat lower PCOS prevalence rate of 6.5% (10). A PCOS prevalence rate of 14.2% according to the Rotterdam criteria has recently been reported from Norway (11). PCOS is characterized by hyperandrogenism, oligomenorrhea, and polycystic ovaries. According to the Rotterdam criteria, PCOS diagnosis requires the presence of at least two of the three criteria (12). Women with PCOS are at an increased risk of developing GDM (13, 14, 15, 16, 17). Women with both PCOS and GDM have a higher risk of developing pregnancy-induced hypertension and preeclampsia and of delivering preterm than those with GDM only (18). Newborns of women with both PCOS and GDM have an increased risk of developing neonatal hyperbilirubinemia (18). Higher levels of oxidative stress markers have recently been reported in neonates of PCOS women, suggesting that PCOS offspring may be at an increased risk of developing later metabolic and cardiovascular diseases (19).

The prevalence of GDM in women with PCOS according to the IADPSG criteria is not known. Whether

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the WHO and the IADPSG criteria identify the same risk factors for GDM development has not been studied. Our aims were to explore the prevalence of GDM in women with PCOS according to both the WHO and the modified IADPSG criteria and to compare the risk factors for GDM development according to the two sets of criteria.

Subjects and methods

Study design

We used data from a previously reported prospective, randomized, double-blind, multicenter study, the PregMet (metformin treatment in pregnant PCOS women) study, where treatment with 2000 mg metformin daily from the first trimester to delivery was compared with that with placebo (20). Inclusion criteria were as follows: i) PCOS diagnosed before pregnancy according to the Rotterdam criteria; ii) age 18–45 years; iii) gestational age between 5 and 12 weeks; and iv) a singleton viable fetus shown on ultrasonography. Inclusion was independent of the mode of conception, including assisted reproductive techniques. Exclusion criteria were as follows: i) alanine aminotransferase concentration >90 IU/l; ii) serum creatinine concentration >130 μmol/l; iii) known alcohol abuse; iv) previously diagnosed diabetes mellitus or fasting serum glucose concentration >7.0 mmol/l at the time point of inclusion, v) treatment with oral glucocorticoids; or vi) use of drugs known to interfere with metformin.

The participants were enrolled at 11 study centers (three university hospitals, seven local hospitals, and one gynecological specialist practice). Overt diabetes mellitus, kidney disease, or liver disease was ruled out before inclusion into the study by determining fasting plasma glucose, serum creatinine, and alanine aminotransferase concentrations. At inclusion, before randomization, a 75 g oral glucose tolerance test (OGTT) and drawing of fasting blood samples were performed. Two-hundred and seventy-four pregnant women were then randomly assigned to either metformin or placebo treatment. All the participants received written and verbal diet advice according to the general guidelines for all pregnant women in Norway. Women diagnosed with GDM according to the WHO criteria used in the original randomized control trial (RCT) received more thorough diet advice. The detailed description of the PregMet study has been published elsewhere (20, 21).

All study participants gave written informed consent before inclusion into the study. The Committee for Medical Research Ethics of Health Region IV, Norway (145-04), and The Norwegian Medicines Agency (2004-000792-33) approved the study. The Declaration of Helsinki was followed throughout the study, and the study was conducted according to the principles of Good Clinical Practice. The study is registered at www.clinicaltrials.gov as NCT00159536.

GDM criteria

GDM was diagnosed i) according to the WHO criteria as fasting plasma glucose concentration ≥ 7.0 mmol/l and/or 2-h plasma glucose concentration ≥ 7.8 mmol/l during a 75 g OGTT at inclusion, pregnancy week 19, and/or pregnancy week 32 and ii) according to the modified IADPSG criteria as fasting plasma glucose concentration ≥ 5.1 mmol/l and/or 2-h plasma glucose concentration ≥ 8.5 mmol/l at the same time points.

One-hour plasma glucose levels, part of the IADPSG criteria, were not measured as we used data from a RCT designed, planned, and initiated before the establishment of the IADPSG criteria. In the HAPO study, 11.1% of the GDM diagnosis according to the IADPSG criteria was set by one elevated glucose value, while 5.0% was set by two or three elevated glucose values. Provided that the elevation of glucose values is evenly distributed, 3.7% of the GDM diagnosis would be set by elevated 1-h values alone. This may be an overestimation as most would suggest that the discrepancy between fasting glucose values, on the one side, and 1- and 2-h glucose values, on the other side, would differ more than that between 1- and 2-h glucose values. However, altogether 17.8% was set by GDM and probably $<3.7\%$ was set by 1-h glucose values only. Accordingly, probably $<21\%$ was set by 1-h glucose values. Thus, the modified IADPSG criteria without 1-h plasma glucose values presumably do not miss that many GDM cases compared with the original IADPSG criteria including 1-h plasma glucose values.

Laboratory methods

Fasting plasma glucose levels were measured using venous blood samples drawn from an antecubital vein between 0800 and 1100 h after an overnight fast. Thereafter, a 75 g OGTT was performed and 2-h plasma samples were drawn. Blood samples were collected and processed in accordance with the local standardized procedures at the participating study centers.

DHEAS and sex hormone-binding globulins (SHBGs) were analyzed using the ELISA technique with the reagents and calibrators supplied by the manufacturer (DRG Instruments GmbH, Marburg, Lahn, Germany). We used the organic solvent extraction method (dichloromethane for testosterone and ethyl ether for androstenedione) prior to quantification to analyze serum testosterone and androstenedione concentrations. For quantification, we used the ELISA technique for testosterone (DRG Instruments GmbH) and Coat-A-Count RIA Kits (Diagnostic Products Corporation, Los Angeles, CA, USA) for androstenedione. The intra- and interassay coefficients of variation were 6.6 and 4.0% for DHEAS, 5.3 and 2.8% for androstenedione, 11.9 and 9.1% for testosterone, and 12.0 and 2.0% for SHBGs respectively. Free testosterone index (FTI) was calculated as follows: (testosterone/

SHBGs)×100. Insulin levels were measured using the ELISA technique with the reagents and calibrators supplied by the manufacturer (DRG Instruments GmbH). Insulin resistance was calculated using the homeostasis model assessment insulin resistance (HOMA-IR) formula (22).

Study outcomes

The primary outcome was the prevalence of GDM in PCOS women according to both the WHO and the modified IADPSG criteria of diagnosis. The secondary outcome was the risk factors for GDM according to the two sets of GDM criteria studied.

Statistical analysis

Baseline characteristics were calculated at inclusion. The prevalence of GDM during pregnancy was computed for different diagnostic criteria. Logistic regression analyses were performed to analyze the association between GDM and the considered risk factors. Risk factors significant at the 10% level in univariate analyses were included in the multivariate analyses. The characteristics of risk factors for normal glucose tolerance (NGT) women and GDM women were computed and equality in distribution was tested using the Wilcoxon's rank sum test.

Results

Patient characteristics

Two-hundred and seventy-three women with PCOS were included in the study. Mean age at inclusion was 29.4±4.4 years. Mean weight and height were 80.9 ±19.1 kg and 167.5±5.7 cm respectively. Mean BMI was 29.0±7.1 kg/m^2. The levels of DHEAS, SHBGs, androstenedione, testosterone, and FTI are given in Table 1. Mean insulin concentration was 15.9 ±10.8 pmol/l and mean HOMA-IR was 3.29±7.1.

Table 1 Characteristics of 273 women with PCOS at inclusion in the first trimester. Values are given as mean±S.D. or number with percentage in parentheses as appropriate.

Characteristics	*n*	Values
Age (years)	273	29.4±4.4
Weight (kg)	273	80.9±19.1
Height (cm)	273	167.5±5.7
BMI (kg/m^2)	273	29.0±7.1
Smoking (*n*)	272	23 (8.5%)
Treatment group	273	
Metformin (*n*)		135 (49.5%)
Placebo (*n*)		138 (50.5%)
Menstruation	273	
Regular (*n*)		36 (13.2%)
Oligomenorrhea (*n*)		195 (71.4%)
Amenorrhea (*n*)		42 (15.4%)
DHEAS (μmol/l)	266	4.87±2.14
SHBGs (nmol/l)	266	213±94
Androstenedione (nmol/l)	266	12.1±7.6
Testosterone (nmol/l)	266	4.4±2.1
FTI	266	0.25±0.20
Insulin (pmol/l)	266	15.9±10.8
HOMA-IR	266	3.29±7.1

Prevalence of GDM

The prevalence rates of GDM diagnosed after using the WHO and the modified IADPSG criteria were 9.2 and 15.0%, 18.7 and 18.7%, and 25.6 and 24.2% at gestational weeks 12, 19, and 32 respectively. The prevalence rates of GDM diagnosed using one set of criteria or both sets of criteria were 27.3, 31.4, and 33.1% at the different time points.

Risk factors for GDM development according to the WHO criteria

The risk factors for WHO-GDM at inclusion in the univariate analyses are given in Table 2. Only short stature and high insulin levels were significant risk factors for WHO-GDM at inclusion in the multivariate analyses.

The risk factors for WHO-GDM at week 19 in the univariate analyses are given in Table 3. Short stature and high insulin levels were significant risk factors for WHO-GDM at week 19 in the multivariate analyses.

At week 32, less weight gain in pregnancy was a significant risk factor for WHO-GDM in both the univariate and the multivariate analyses. Short stature was a significant risk factor for WHO-GDM in the multivariate analyses.

Risk factors for GDM development according to the modified IADPSG criteria

The risk factors for modified IADPSG-GDM at inclusion in the univariate analyses are given in Table 2. None of these variables were significant risk factors for modified IADPSG-GDM at inclusion in the multivariate analyses.

The risk factors for modified IADPSG-GDM at week 19 in the univariate analyses are given in Table 3. None of these variables were significant risk factors for modified IADPSG-GDM in the multivariate analyses.

The risk factors for modified IADPSG-GDM at week 32 in the univariate analyses are given in Table 4. Only reduced weight gain was a significant risk factor for modified IADPSG-GDM in the multivariate analyses.

Maternal and offspring characteristics according to the GDM criteria

Women with WHO-GDM lost less weight *post-partum* than those without WHO-GDM (−5.7±1.1 vs −9.3± 1.2 kg; $P=0.013$). Children born to WHO-GDM women

Table 2 Risk factors in the first trimester (at inclusion) for GDM throughout pregnancy according to different diagnostic criteria: univariate and multivariate analyses.

	WHO[a]			IADPSG[b]		
	β	S.E.M.	*P* value	β	S.E.M.	*P* value
Univariate analyses						
Age (years)	0.064	0.033	0.050	0.057	0.034	0.093
Weight (kg)	0.009	0.007	0.21	0.017	0.007	0.019
Height (cm)	−0.063	0.026	0.017	−0.018	0.026	0.48
BMI (kg/m^2)	0.031	0.019	0.10	0.041	0.019	0.033
Treatment group (0=metformin and 1=placebo)	0.208	0.284	0.47	0.292	0.293	0.32
Parity (*n*)	0.318	0.193	0.099	0.29	0.206	0.16
Smoker (1=yes and 0=no)	0.387	0.498	0.44	0.031	0.553	0.96
DHEAS (μmol/l)	0.048	0.066	0.47	0.056	0.068	0.41
SHBG (nmol/l)	−0.003	0.002	0.096	−0.004	0.002	0.032
Androstenedione (nmol/l)	−0.026	0.021	0.22	−0.028	0.022	0.22
Testosterone (nmol/l)	0.023	0.066	0.73	−0.035	0.075	0.65
FTI	0.850	0.975	0.38	1.453	1.002	0.15
Insulin (pmol/l)	0.030	0.014	0.028	0.014	0.012	0.26
Multivariate analyses[c]						
Age (years)	0.054	0.038	0.15	0.052	0.035	0.14
Height (cm)	−0.06	0.028	0.032			
Parity (*n*)	0.147	0.222	0.51			
SHBG (nmol/l)	−0.003	0.002	0.13	−0.003	0.002	0.083
Insulin (pmol/l)	0.027	0.013	0.044			
Weight (kg)				0.015	0.016	0.37
BMI (kg/m^2)				−0.008	0.044	0.85

[a]Two-hundred and six observations with non-missing risk factors.
[b]One-hundred and eighty-three observations with non-missing risk factors.
[c]Variables were included in the multivariate model if $P<0.1$ in the univariate analyses.

had less weight gain in the first year of their life than those born to women without WHO-GDM (5.78±1.14 vs 6.06±1.11 kg; $P=0.056$). Women with modified IADPSG-GDM lost less weight *post-partum* than those without modified IADPSG-GDM (−4.7±1.7 vs −9.9±1.2 kg; $P=0.026$). Children born to women with modified IADPSG-GDM had less weight gain in the first year of their life than those born to women without modified IADPSG-GDM (5.69±0.14 vs 6.07±0.11 kg; $P=0.025$; Table 5).

Table 3 Risk factors at week 19 for GDM throughout pregnancy according to different diagnostic criteria: univariate and multivariate analyses.

	WHO[a]			IADPSG[b]		
	β	S.E.M.	*P* value	β	S.E.M.	*P* value
Univariate analyses						
Weight (kg)	0.009	0.007	0.24	0.019	0.008	0.015
Weight increase since inclusion (kg)	−0.043	0.053	0.42	−0.067	0.056	0.23
BMI (kg/m^2)	0.04	0.021	0.058	0.056	0.022	0.01
DHEAS (μmol/l)	0.09	0.078	0.26	−0.012	0.085	0.89
SHBG (nmol/l)	−0.002	0.002	0.11	−0.001	0.002	0.47
Androstenedione (nmol/l)	−0.034	0.029	0.23	−0.039	0.03	0.19
Testosterone (nmol/l)	−0.122	0.08	0.13	−0.121	0.082	0.14
FTI	−0.966	1.941	0.62	−1.825	2.038	0.37
Insulin (pmol/l)	0.031	0.013	0.019	0.032	0.014	0.025
Multivariate analyses[c]						
Age (years)	0.056	0.039	0.16	0.056	0.036	0.13
Height (cm)	−0.07	0.029	0.017			
Parity (*n*)	0.079	0.226	0.73			
BMI (kg/m^2)	−0.002	0.025	0.93	0.022	0.07	0.76
Insulin (pmol/l)	0.039	0.016	0.014	0.027	0.016	0.094
Weight (kg)				0.003	0.024	0.90

[a]Two-hundred and five observations with non-missing risk factors.
[b]One-hundred and seventy-eight observations with non-missing risk factors.
[c]Variables were included in the multivariate model if $P<0.1$ in the univariate analyses.

Table 4 Risk factors at week 32 for GDM throughout pregnancy according to different diagnostic criteria: univariate and multivariate analysis.

	WHO[a]			IADPSG[b]		
	β	S.E.M.	*P* value	β	S.E.M.	*P* value
Univariate analyses						
Weight (kg)	0.007	0.008	0.392	0.019	0.008	0.02
Weight increase from inclusion to week 36 (kg)	−0.110	0.036	0.002	−0.104	0.037	0.005
BMI (kg/m^2)	0.038	0.023	0.092	0.058	0.023	0.011
DHEAS (μmol/l)	−0.067	0.099	0.5	−0.187	0.111	0.093
SHBG (nmol/l)	0.00	0.001	0.75	0.00	0.001	0.81
Androstenedione (nmol/l)	−0.044	0.021	0.04	−0.046	0.022	0.038
Testosterone (nmol/l)	−0.087	0.057	0.13	−0.058	0.053	0.28
FTI	−3.187	1.951	0.10	−1.769	1.738	0.31
Insulin (pmol/l)	0.01	0.012	0.44	0.017	0.013	0.17
Multivariate analyses[c]						
Age (years)	0.024	0.042	0.57	0.017	0.04	0.68
Height (cm)	−0.06	0.029	0.039			
Parity (*n*)	−0.006	0.241	0.98			
Weight increase since week 12 (kg)	−0.112	0.039	0.004	−0.111	0.047	0.018
BMI (kg/m^2)	0.015	0.025	0.56	0.072	0.076	0.34
Androstenedione (nmol/l)	−0.038	0.022	0.089	−0.03	0.023	0.19
Weight (kg)				−0.005	0.026	0.86
DHEAS (μmol/l)				−0.121	0.124	0.33

[a]One-hundred and ninety-four observations with non-missing risk factors.
[b]One-hundred and seventy observations with non-missing risk factors.
[c]Variables were included in the multivariate model if $P<0.1$ in the univariate analyses.

Discussion

In the present *post hoc* analysis of a randomized, multicenter study, we found that the WHO and the modified IADPSG criteria for GDM diagnosis identify the same number of women with GDM. Early in pregnancy, however, more women meet the GDM criteria according to the modified IADPSG criteria than according to the WHO criteria. Women diagnosed according to the two sets of criteria differ in patient characteristics and in risk factors of GDM development. Less than one-third of the women with GDM according to either of the criteria sets fulfilled both diagnostic modes. GDM diagnosis correlated with less maternal weight loss the first year *post-partum*.

A general increase in GDM incidence when using the IADPSG criteria instead of the WHO criteria is well documented (23, 24). To our knowledge, the prevalence of GDM according to the IADPSG criteria in PCOS women has not been reported previously. Contrary to most other studies that have reported a higher prevalence rate of GDM when applying the IADPSG criteria than when applying the WHO criteria, we found similar prevalence rates of GDM irrespective of the mode of diagnosis in women with PCOS. Of course, an explanation for this may be that we used the modified IADPSG criteria without 1-h glucose values and thus reported lower GDM incidence than what the truth is. However, as has been outlined previously, adding 1-h plasma glucose values probably increases GDM incidence by $<21\%$. The confirmation of our findings in future studies would result in the possibility of the pathogenesis for GDM in women with PCOS being different from that for women without PCOS.

Table 5 Offspring and maternal characteristics for different diagnostic criteria.

	WHO			IADPSG		
	NGT (*n*=128)	GDM (*n*=59)		NGT (*n*=122)	GDM (*n*=52)	
	Mean±S.E.M.	Mean±S.E.M.	*P* value	Mean±S.E.M.	Mean±S.E.M.	*P* value
Birth weight (g)	3547±48	3522±78	0.71	3516±50	3567±78	0.59
Offspring weight at 1 year (kg)	9.98±0.11	9.69±0.15	0.091	9.96±0.12	9.65±0.15	0.17
Offspring weight change in the first year (kg)	6.06±0.11	5.78±0.14	0.056	6.07±0.11	5.69±0.14	0.025
Maternal weight at week 36 (kg)	91.1±1.9	88.9±2.40	0.9	90.3±1.9	92.3±3.0	0.44
Maternal weight 1 year *post-partum* (kg)	81.1±2.0	82.9±2.3	0.19	79.7±1.9	87.1±3.2	0.033
Maternal weight change *post-partum* (kg)	−9.3±1.2	−5.7±1.1	0.013	−9.9±1.2	−4.7±1.7	0.026
Maternal BMI at week 36 (kg/m^2)	31.8±0.7	31.7±0.9	0.66	31.7±0.7	32.6±1.1	0.31
Maternal BMI 1 year *post-partum* (kg/m^2)	28.3±0.7	29.3±0.8	0.11	27.9±0.7	30.6±1.1	0.025
Maternal BMI change (kg/m^2)	−2.9±0.4	−1.7±0.4	0.017	−3.2±0.42	−1.3±0.57	0.015

Risk factors for GDM throughout pregnancy vary by the diagnostic criteria used. At inclusion and at week 19, short stature and high insulin levels were the risk factors for WHO-GDM throughout pregnancy, but not for modified IADPSG-GDM throughout pregnancy. Short stature has lately emerged as a risk factor for GDM in women without PCOS (25). Interestingly, less weight gain in pregnancy predicted GDM in late pregnancy according to both the WHO and the modified IADPSG criteria. This observation contradicts common wisdom and the vast majority of scientific reports in which increased weight gain has been reported to be associated with GDM (26, 27, 28, 29, 30). One report, however, supports our finding (31). A possible explanation may be that GDM occurs more frequently in obese women, and obese women gain less weight during pregnancy than those with normal prepregnancy weight. Our data, however, show no difference in baseline BMI between women who developed GDM and those who did not. Possibly it is PCOS *per se* and not obesity that is associated with GDM. Han *et al.* (32), however, found that GDM morbidity was significantly higher in obese PCOS women than in nonobese PCOS women, suggesting that GDM is associated with obesity and not with PCOS *per se*. A high prevalence of elevated HbA1c levels in nonobese women with PCOS and an increased risk of elevated HbA1c levels in PCOS in a recent case–control study, however, support our hypothesis (33). The authors of the latter study suggest that HbA1c as a diagnostic tool in diabetes screening may be of help in young nonobese PCOS women. A recent Danish retrospective observational study of PCOS women, on the other hand, has found HbA1c to be a poor marker in diagnosing type 2 diabetes, but found HbA1c to be associated with BMI, waist and lipid profiles, thus suggesting its role as a cardiovascular risk marker in women with PCOS (34).

Post-partum, GDM diagnosis correlates with less maternal weight loss irrespective of the mode of GDM diagnosis. The association between GDM and later type 2 diabetes mellitus is well documented (35). Our data indicate that this association may partly be explained by the lower weight loss *post-partum* and not so much by the diagnosis of GDM itself. In a pilot randomized trial, Ferrara *et al.* (36) have recently reported that GDM women receiving prenatal/*post-partum* intervention to modify diet and physical activity show a higher probability of reaching *post-partum* weight goal (defined as prepregnancy weight if BMI $<25\ kg/m^2$ and -5% of prepregnancy weight if BMI $>25\ kg/m^2$) 12 months *post-partum*. The associations among maternal weight changes, HbA1c levels in PCOS women, GDM, type 2 diabetes, and later cardiovascular disease should be explored further.

Less than one-third of women with GDM met both the WHO and the modified IADPSG criteria. The discrepancy between WHO-GDM prevalence and modified IADPSG-GDM prevalence was highest early in pregnancy. Given the well-documented adverse effects of GDM, early detection may improve maternal and fetal outcomes (37, 38, 39). The high discrepancy between WHO-GDM prevalence and modified IADPSG-GDM prevalence in early pregnancy in women with PCOS is noteworthy and should be explored further before changing routines.

A weakness of the study is the high and partly divergent intra- and interassay coefficients, especially concerning testosterone and SHBG levels. Furthermore, women diagnosed with GDM according to the WHO criteria in the original RCT got more thorough diet advice than did the entire study population, potentially influencing WHO-GDM outcomes throughout pregnancy and the extent of diagnostic overlap between the WHO and the modified IADPSG criteria in this *post hoc* analysis. The strengths of the study are the homogenous population of Caucasian women with well-documented PCOS and a structured follow-up with three OGTT measurements in pregnancy. The small number of dropouts, the high prevalence of GDM, and the frequent laboratory hormone analyses are also advantages. To our knowledge, no other report of comparable size and quality comparing GDM incidence and risk factors according to different diagnostic GDM criteria in women with PCOS has been published.

Conclusion

The WHO and the modified IADPSG criteria for GDM diagnosis identify the same number of women with PCOS throughout pregnancy. However, less than one-third of PCOS women with GDM fulfill the two sets of diagnostic criteria. Risk factors for GDM differ according to the diagnostic criteria used, but less weight gain in pregnancy seems to be a risk factor independent of the mode of diagnosis. Less maternal weight loss the first year *post-partum* in PCOS women with GDM can partly explain the well-known association between GDM and later type 2 diabetes mellitus.

Declaration of interest

The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

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Author contribution statement

S M Carlsen and E Vanky made substantial contributions to the conception and design of the randomized multicenter study and

revised the manuscript critically before submission. S M Carlsen created study aims. Ø Salvesen computed the statistical analyses with substantial contribution from S M Carlsen. R Helseth wrote drafts of the article and made substantial contributions to the final version to be published.

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