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REGULAR ARTICLE

Recent gestational diabetes was associated with mothers stopping predominant breastfeeding earlier in a multi-ethnic population

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ABSTRACT
Aim: It has previously been shown that breastfeeding may reduce the risk of type 2 diabetes in mothers with recent gestational diabetes mellitus (GDM). This study compared the cessation of predominant breastfeeding in mothers with and without recent GDM in a multi-ethnic population.
Methods: From May 2008 to May 2010, healthy pregnant women attending antenatal care provided by community health services in Eastern Oslo, Norway were recruited. We included 616 women–58% non-Western–and interviewed and examined them at a mean of 15 and 28 weeks of gestation and 14 weeks' postpartum. Cox regression models examined the association between GDM, as assessed by the 2013 World Health Organization criteria, and breastfeeding cessation.
Results: Overall, 190 of the 616 (31%) mothers had GDM and they ended predominant breastfeeding earlier than mothers without GDM, with an adjusted hazard ratio (aHR) of 1.33 and 95% confidence interval (95% CI) of 1.01–1.77. Mothers of South Asian origin ended predominant breastfeeding earlier than Western European mothers in the adjusted analysis (aHR 1.53, 95% CI: 1.04–2.25), but Middle Eastern mothers did not.
Conclusion: Recent gestational diabetes was associated with earlier cessation of predominant breastfeeding in Western European and non-Western women.

BACKGROUND
Gestational diabetes mellitus (GDM) is a common complication of pregnancy (1,2). Although hyperglycaemia is usually resolved after delivery, a meta-analysis has shown that women with previous gestational diabetes had a sevenfold increased risk of developing type 2 diabetes in the following 5–10 years, compared to those with normal glucose levels during pregnancy (3). Breastfeeding has been found to be associated with a reduced risk of type 2 diabetes in both healthy mothers (4) and mothers with previous gestational diabetes (5). It is hypothesised that lactation contributes to resetting women's metabolisms after pregnancy, as studies have shown that breastfeeding may favourably affect glucose metabolism and insulin sensitivity (6,7). Being breastfed has been associated with reductions in overweight or obesity and type 2 diabetes in children (8), although findings from studies on the children of mothers

Abbreviations
BMI, Body mass index; CI, Confidence interval; GDM, Gestational diabetes mellitus; HR, Hazard ratio; IQR, Interquartile range; SD, Standard deviation; WHO, World Health Organization.

Key notes
- It has previously been shown that breastfeeding may reduce the risk of type 2 diabetes in mothers with recent gestational diabetes mellitus (GDM).
- This Norwegian study of 616 women living in multi-ethnic districts found that mothers with recent GDM ended predominant breastfeeding earlier than mothers without GDM.
- Mothers of South Asian, but not Middle Eastern, origin ended predominant breastfeeding earlier than Western European mothers in the adjusted analysis.

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with GDM were inconsistent (9). Whereas studies have found lower rates of initiation of exclusive breastfeeding after GDM (10–12), country-specific differences have been observed for the continuation of exclusive and predominant breastfeeding (2,13,14).

In the Norwegian Stork Groruddalen cohort, the prevalence of GDM was higher in women of South Asian and Middle Eastern origin, compared to Western European women (1). Previous studies have found that women of Asian origin had a much higher risk of developing diabetes one to two years postpartum, compared with European women (15,16). Breastfeeding may therefore be of particular importance for some ethnic groups.

Given the potential of breastfeeding to reduce the risk of future type 2 diabetes in women with GDM and in their offspring, our objective was to assess the association between GDM and breastfeeding in a multi-ethnic population.

METHODS

The primary aim of the Stork Groruddalen cohort study was to identify predictors of GDM and foetal growth in a multi-ethnic population in Groruddalen, Oslo, Norway, from May 2008 to May 2010**.** The current study was a sub-study of the Stork Groruddalen cohort and only included women who attended the postnatal visit. Details of the study methods have previously been described (17). Briefly, general practitioners were asked to refer healthy pregnant women to the maternal and child community health services early in pregnancy. Women were eligible if they were living in the study area, planned to give birth at one of the two study hospitals, were less than 20 weeks pregnant and could communicate in Norwegian, Arabic, English, Sorani, Somali, Tamil, Turkish, Urdu or Vietnamese. Women with pregestational diabetes were excluded. Women were examined at a mean of 15 and 28 weeks of gestation and 14 weeks' postpartum. Overall, 823 (74%) of the women who were invited to participate in the study took part, 772 (94%) attended the visit around week 28 and 662 (80%) attended the postpartum visit (17). Of the included women, 487 (59%) were of ethnic minority origin. Information about maternal age, education, parity, body mass index before pregnancy, smoking habits before pregnancy and ethnic origin was collected at the time of inclusion and depression in pregnancy at 28 weeks of gestation. Specially trained and certified midwives, assisted by professional interpreters, when needed, completed the questionnaires. Data on delivery mode, birthweight, gestational age and Apgar score were collected from the hospital records. Gestational weight gain was self-reported at the postpartum visit. In this sub-study, we only excluded mothers delivering with twins. The study was approved by The Norwegian Regional Ethics Committee and The Norwegian Data Inspectorate. Written consent was obtained for all participants.

A standard 75 g oral glucose tolerance test (OGTT) was performed at 28 weeks of gestation (17), and venous blood glucose was measured on site with a HemoCue 201+ (HemoCue AB, Angelholm, Sweden), which was calibrated for plasma (17). During the data collection period from 2008 to 2010, women were diagnosed with GDM according to the Norwegian standard that was being used at that time, which was the World Health Organization (WHO) 1999 criteria. That defined GDM as fasting plasma glucose ≥7.0 or two-hour plasma glucose ≥7.8 mmol/L (18). Women with two-hour values 7.8–8.9 mmol/L were given lifestyle advice and referred to their general practitioner for follow-up, while women with fasting plasma glucose of ≥7.0 mmol/L or two-hour values ≥9.0 mmol/L were referred to specialist care (1). In this sub-study, we used the WHO 2013 diagnostic criteria for GDM: fasting plasma glucose ≥5.1 or two-hour glucose ≥8.5 mmol/L. One-hour values were not available (19).

Breastfeeding status was assessed around 14 weeks' postpartum (range 8–18 weeks), with retrospective questions covering the period since birth, using similar questions as in the Norwegian infant feeding survey (20). Those who had ceased breastfeeding were asked to tick the age when breastfeeding was stopped; the scale was in single weeks up to seven weeks of age and then in half months from the age of two months and onwards. The any breastfeeding category included both breastfeeding with and without additional food or liquid. To assess the duration of predominant breastfeeding, we asked if they had breastfed, for how long they had breastfed and at what age the infant was introduced to infant formula, solids or sweet liquids. In accordance with the WHO definitions (21), we used the term predominant breastfeeding for infants who received breast milk, possibly with plain water, but with no other food or liquid.

Ethnic origin was defined by the country where the participating woman was born, but if the participating woman's mother was born outside Europe or North America we used her country of birth to define ethnic origin of the participant. Women whose ethnic origin was Eastern Europe, Asia, Middle East and Africa are referred to as ethnic minority women. For this study, we used the following categories: Western Europe (primarily Norway, Sweden and Denmark), South Asia (primarily Pakistan and Sri Lanka), the Middle East (primarily Iraq, Turkey, Morocco and Afghanistan) and other (including Somalia, Vietnam, the Philippines, Poland and Russia). Body mass index before pregnancy was dichotomised to ≥30 and <30 kg/m^2. The Edinburgh Postnatal Depression Scale (EPDS), a 10-item, self-rating scale, was used to assess depression in gestational week 28 in pregnancy (17). Maternal education was reported as levels ranging from none to a masters degree or more. As few Western European women had primary education or less, this explanatory factor was dichotomised into high school or less education or university or college education. The mothers' smoking habits three months prior to pregnancy were reported as never, occasional or daily and was dichotomised into daily smoking or no or occasional smoking. Parity was categorised as either primiparous or multiparous. Mode of delivery was classified as spontaneous vaginal birth, instrument assisted delivery and Caesarean section. Birthweight was categorised according to the quartiles. Maternal age, gestational weight gain and gestational age were treated as continuous variables.

Statistical analysis

To compare the characteristics of the GDM and non-GDM mother–infant pairs, we used the *t*-test for differences in the means and the Mann-Whitney *U*-test for differences in the medians. Differences between the categorical variables were tested using the chi-square test. Kaplan-Meier survival analyses were conducted to compare the end of predominant and any breastfeeding in mothers with and without GDM using the log-rank chi-square test. The Cox proportional hazard regression analysis was used to assess whether GDM was associated with predominant or any breastfeeding in two models. The age of the child when breastfeeding ceased was used as the time to event. Similar to The Environmental Determinants of Diabetes in the Young (TEDDY) birth cohort study (13), we included the following potentially confounding factors in model one: obesity in pregnancy, gestational weight gain, ethnic background, maternal age, education, smoking before pregnancy, parity, depression in pregnancy. In model two, we also included mode of delivery, birthweight, gestational age and Apgar score. We conducted interaction analyses to explore possible effect modifications of ethnic origin on the effect of relevant covariates, namely GDM, obesity, depression in pregnancy, maternal education and parity on predominant breastfeeding. The statistical analyses were performed using SPSS version 23 (IBM Corporation, Armonk, NY, USA).

RESULTS

Of the 823 women enrolled, 13 women had abortions, six had stillbirths, 36 had missing information on GDM status, eight mothers with twins were excluded and 113 did not attend the postpartum visit. Of those who attended, there were inconsistencies in the reported age of the child in 12 participants and 19 had missing information on breastfeeding, leaving a study sample of 616 (Appendix S1).

In this sub-study, 190 of the 616 (31%) women had GDM according to the WHO 2013 criteria (19) and six were treated with medication. Women from South Asia (65/154, 42%) and the Middle East (33/87, 38%) were much more likely to be diagnosed with gestational diabetes than women from Western Europe (62/261, 24%) and women from

Table 1 Characteristics of the study sample by history of gestational diabetes ($n = 616$)

	Mothers with recent gestational diabetes				
	No ($n = 426$)		Yes ($n = 190$)		p Value
Maternal age (years) (mean, SD)*	29.8	(4.6)	30.6	(5.2)	0.07
Prepregnancy BMI ≥ 30 kg/m^2 (%)	9.2		21.7		<0.01
Gestational weight gain (kg) (median, IQR)†	13.0	(9.0–17.0)	13.0	(8.5–17.5)	0.34
Ethnic background (%)					
Western	46.7		32.6		<0.01
South Asia	20.9		34.2		
Middle East	12.7		17.4		
Other	19.7		15.8		
Maternal education (%)					
High school or less	49.6		63.0		<0.01
College/university	50.4		37.0		
Smoking before pregnancy (regular) (%)	11.6		7.9		0.16
Primiparous (%)	48.1		44.2		0.37
Depression in pregnancy, EPDS ≥ 10 (%)	12.0		15.7		0.21
Mode of delivery (%)					
Vaginal	75.4		66.8		0.09
Instrumental	9.2		11.6		
Caesarean	15.5		21.6		
Birthweight (%)					
<25 percentile (<3080 g)	25.4		23.7		
25–75 percentile (3080–3790 g)	52.1		46.3		
>75 percentile (>3790 g)	22.5		30.0		0.14
Gestational age (weeks) (median, IQR)†	40.0	(39.0–41.0)	40.3	(39.2–41.4)	0.82
Apgar score, one minute ≥8 (%)	93.2		91.6		0.48

EPDS = Edinburgh Postnatal Depression Scale.
p value for chi-square test.
**t*-test.
†Mann–Whitney *U*-test.

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Table 2 Characteristics of the study sample by predominant breastfeeding for those retained in the sample by 12 weeks

Characteristics	Predominant breastfeeding at 12 weeks Yes (n = 341) (%)	No (n = 192) (%)	p Value*
Gestational diabetes			
Yes	56	44	0.02
No	67	33	
Prepregnancy BMI			
$\geq$30 kg/m^2	44	56	<0.01
<30 kg/m^2	67	33	
Gestational weight gain			
$\geq$13 kg	66	34	0.18
<13 kg	61	39	
Ethnic background			
Western	70	30	0.02
South Asia	53	47	
Middle East	63	37	
Other	67	33	
Maternal age			
<30 years	60	40	0.04
$\geq$30 years	68	32	
Maternal education			
High school or less	58	42	<0.01
College/university	70	30	
Smoking before pregnancy (regular)			
No	65	35	0.18
Yes	56	44	
Parity			
Primiparous	58	42	0.01
Multiparious	69	31	
Depression in pregnancy			
EPDS $\geq$ 10	52	48	0.03
EPDS <10	66	34	
Mode of delivery			
Vaginal	68	32	0.01
Instrumental	50	50	
Caesarean	56	44	
Birthweight			
<25 percentile (<3080 g)	56	44	0.03
25–75 percentile (3080–3790 g)	69	31	
>75 percentile (>3790 g)	63	37	
Gestational age			
<37 weeks	58	42	0.56
$\geq$37 weeks	64	36	
Apgar score, one minute $\geq$8			
$\geq$8	65	35	0.34
<8	57	43	

EPDS = Edinburgh Postnatal Depression Scale.
*p value for chi-square test.

other countries (30/114, 26%). There was a statistically significant association between the presence of GDM and a body mass index of $\geq$30 kg/m^2 in pregnancy, ethnic background and maternal education (Table 1). Table 2 shows the characteristics of the study sample by predominant breastfeeding for those who stayed in the study for at least 12 weeks.

Breastfeeding was initiated in 99% of both GDM and non-GDM mothers. In the first week after delivery, 86% of GDM mothers versus 91% of non-GDM mothers breastfed predominantly ($p = 0.07$). From the second week, significant differences between the GDM and non-GDM mothers emerged, as 78% of the GDM mothers and 88% of the non-GDM mothers breastfed predominantly ($p < 0.01$). This difference persisted for those who were still in the study at 12 weeks, when 56% of the GDM and 67% the non-GDM mothers breastfed predominantly ($p = 0.02$).

In the unadjusted analyses, predominant breastfeeding in mothers with GDM ended significantly earlier than in non-GDM mothers, with an unadjusted hazard ratio (HR) of 1.52 and 95% confidence interval (95% CI) of 1.18–1.97 ($p < 0.001$) (Table 3, Fig. 1). The association between GDM and predominant breastfeeding remained significant after adjustment for sociodemographic factors, ethnic origin, body mass index, gestational weight gain, smoking and depression in pregnancy (HR 1.35, 95% CI: 1.02–1.78, $p = 0.04$) and after additional adjustment for factors related to mode of delivery and to the neonate (HR 1.33, 95% CI: 1.01–1.77, $p < 0.05$) (Table 3). Any breastfeeding ended significantly earlier in GDM mothers compared to non-GDM mothers (HR 1.42, 95% CI: 1.10–1.84, $p < 0.05$), but lost statistical significance after adjustments in model one and model two (Appendix S2).

In the unadjusted analyses, predominant breastfeeding ended significantly earlier in the 154 mothers of South Asian origin (HR 1.54, 95% CI: 1.13–2.10, $p < 0.01$) and 87 women of Middle-Eastern origin (HR 1.47, 95% CI: 1.02–2.12, $p = 0.04$) compared with the 261 Western European women, which was the reference group (Table 3, Appendix S3). This association remained statistically significant in women with a South-Asian origin in the fully adjusted model (HR 1.53, 95% CI: 1.04–2.25, $p = 0.03$), but not in mothers with a background from the Middle-East (Table 3). The association between GDM and predominant breastfeeding was similar in South Asian (unadjusted HR 1.61, 95% CI: 1.07–2.62) and Western European women (unadjusted HR 1.68, 95% CI: 1.19–2.53). There was no statistically significant interaction between ethnic origin and GDM on predominant breastfeeding (p value for interaction = 0.417).

Obesity and smoking before pregnancy was associated with earlier cessation of predominant breastfeeding in the fully adjusted model. Instrument assisted delivery was associated with significantly earlier cessation of predominant breastfeeding in the unadjusted analyses and this remained of borderline significance in the fully adjusted model (Table 3).

DISCUSSION

In this population-based multi-ethnic cohort study, most of the women initiated any breastfeeding, regardless of GDM status defined according to the WHO 2013 criteria.

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Table 3 Risk of cessation of predominant breastfeeding before 18 weeks by history of GDM and other covariates (n = 616) assessed by unadjusted regression and adjusted for prepregnancy obesity, gestational weight gain, ethnic background, maternal age, education, smoking before pregnancy, parity and depression in pregnancy (Model 1) and additionally for mode of delivery, birthweight, gestational age and Apgar score (Model 2)

	Unadjusted model			Model 1			Model 2		
	HR	(95% CI)	p Value	HR	(95% CI)	p Value	HR	(95% CI)	p Value
Gestational diabetes									
No	1			1			1		
Yes	**1.52**	**(1.18–1.97)**	**<0.01**	**1.35**	**(1.02–1.78)**	**0.04**	**1.33**	**(1.01–1.77)**	**<0.05**
Prepregnancy BMI ≥ 30 (kg/m^2)	**1.90**	**(1.38–2.61)**	**<0.01**	**1.78**	**(1.25–2.55)**	**<0.01**	**1.80**	**(1.25–2.59)**	**<0.01**
Gestational weight gain (kg)	0.99	(0.97–1.01)	0.21	0.99	(0.96–1.01)	0.22	0.99	(0.96–1.01)	0.24
Ethnic background									
Western	1			1			1		
South Asia	**1.54**	**(1.13–2.10)**	**<0.01**	**1.63**	**(1.12–2.37)**	**0.01**	**1.53**	**(1.04–2.25)**	**0.03**
Middle East	**1.47**	**(1.02–2.12)**	**0.04**	1.37	(0.89–2.12)	0.15	1.41	(0.91–2.18)	0.13
Other	1.11	(0.77–1.60)	0.57	1.03	(0.70–1.52)	0.88	1.01	(0.68–1.50)	0.98
Maternal age (years)	**0.97**	**(0.95–0.99)**	**<0.05**	0.99	(0.96–1.03)	0.73	0.99	(0.96–1.02)	0.54
Maternal education, College/university	**0.70**	**(0.54–0.90)**	**<0.01**	0.85	(0.63–1.15)	0.30	0.84	(0.63–1.14)	0.26
Smoking before pregnancy (regular)	1.36	0.94–1.98)	0.10	**1.81**	**(1.19–2.74)**	**<0.01**	**1.72**	**(1.13–2.61)**	**0.01**
Primiparous	1.22	(0.95–1.57)	0.12	1.30	(0.97–1.76)	0.08	1.18	(0.87–1.60)	0.30
Depression in pregnancy, EPDS ≥ 10	1.36	(0.97–1.92)	0.08	1.17	(0.82–1.67)	0.38	1.15	(0.80–1.65)	0.47
Mode of delivery									
Vaginal	1						1		
Instrumental	**1.62**	**(1.11–2.36)**	**0.01**				1.47	(0.97–2.25)	0.07
Caesarean	1.34	(0.98–1.84)	0.07				1.29	(0.91–1.83)	0.16
Birthweight (g)									
<25 percentile (<3080 g)	**1.39**	**(1.04–1.86)**	**0.03**				1.20	(0.86–1.69)	0.28
25–75 percentile (3080–3790 g)	1						1		
>75 percentile (>3790 g)	1.08	(0.79–1.47)	0.65				1.03	(0.73–1.46)	0.85
Gestational age (weeks)	0.94	(0.87–1.01)	0.10				0.96	(0.88–1.05)	0.39
Apgar score, one minute ≥8	1.32	(0.85–2.04)	0.22				1.14	(0.70–1.87)	0.60

EPDS = Edinburgh Postnatal Depression Scale; HR = Hazard Ratio.
Numbers in bold indicate p Values <0.05.

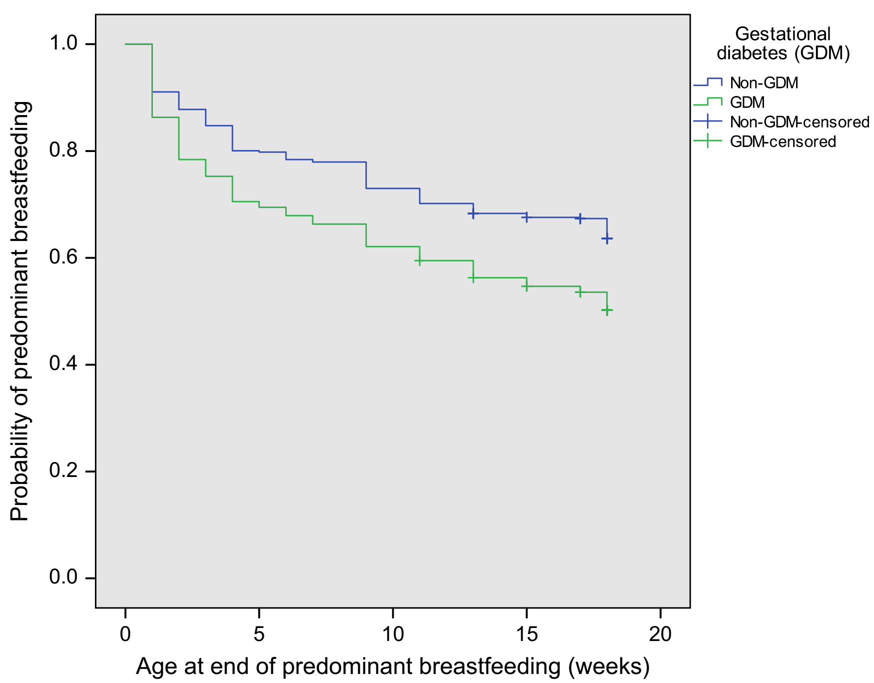

Figure 1 Kaplan–Meier survival curve for predominant breastfeeding by GDM (log rank test p = 0.001).

However, a lower proportion of mothers with recent GDM breastfed predominantly in the first and second weeks after delivery. Importantly, our study showed that mothers with recent GDM were also more likely to end predominant breastfeeding earlier than mothers without GDM and this association was similar in South Asian and Western European women. Furthermore, South Asian ethnic origin was associated with a shorter period of predominant breastfeeding, compared to Western European mothers, independent of GDM and obesity.

In line with previous studies, we observed lower rates of predominant breastfeeding in the first two weeks after delivery in mothers with recent GDM (10–12). Our finding of an earlier cessation of predominant breastfeeding after GDM supports the findings of studies from Denmark (14) and Spain (2). However, in the TEDDY study, country-specific differences were observed, with a strong association between maternal GDM and an earlier end to exclusive breastfeeding in Sweden and the USA, but not Finland and Germany (13).

The association between recent GDM and earlier cessation of predominant breastfeeding may relate to characteristics of both the mother and child and medical procedures. In the mother, GDM has been found to increase the prevalence of other risk factors for the earlier discontinuation of predominant breastfeeding, such as pre-eclampsia, Caesarean section, instrument assisted delivery and delayed onset of lactation (22,23). In our study, instrument assisted delivery seemed to reduce the duration of predominant breastfeeding. Delayed onset of lactation, defined as copious milk coming in later than three days postpartum, has been shown to increase the risk of excess neonatal weight loss and shorter breastfeeding duration (22). Some studies have suggested that suboptimal glucose tolerance and insulin resistance may interfere with the hormonal pathways involved in the onset of lactation (22). We did not investigate the timing of the onset of copious milk production, but our finding of an increased level of nonexclusive breastfeeding in the first and second weeks of life may indicate delayed onset of lactation. In the child, GDM has been found to increase the risk of neonatal hypoglycaemia, hyperbilirubinaemia and a birthweight above the 90th percentile (23). Also, infants born to mothers with higher glucose concentrations have been shown to have a significant catch-down weight in infancy (24). Some of these infants, but not all, may need to be supplemented with infant formula and hospital procedures on the management of these conditions may affect breastfeeding (25). The country-specific differences in the influence of GDM on exclusive breastfeeding between Sweden and Finland in the TEDDY study were not explained, but it was hypothesised that different neonatal feeding guidelines and practices could be the cause (13). At present we do not know whether, or to what extent, the earlier cessation of predominant breastfeeding in mothers with recent GDM is explained by modifiable factors.

In line with most other studies, we observed that maternal obesity was associated with an earlier cessation of predominant breastfeeding (26). However, most studies have only included women with a European origin. Studies including women of different ethnic backgrounds have found that obesity may impact breastfeeding in different ways (27). We did not observe this in our study.

The breastfeeding pattern in many countries in South Asia and the Middle East is characterised by late initiation of breastfeeding and short periods of exclusive breastfeeding, but a long duration of any breastfeeding (Appendix S4). Our finding of earlier cessation of predominant breastfeeding in women from South Asia and possibly those from the Middle East, reflected breastfeeding practices in their region of origin (28). Jenum et al. (29) reported that migrants from South Asia had a risk of type 2 diabetes that was at least four times higher than native Norwegians. Lifestyle interventions have been shown to be less effective at preventing the transition from GDM to diabetes in South Asian populations (30). Because of this, supporting women to achieve optimal breastfeeding practices may be an additional way of reducing the risk of type 2 diabetes in childbearing women.

Strengths and limitations

The strengths of this study were the multiethnic, population-based cohort design, universal screening by the oral glucose tolerance test at 28 weeks of gestation and the high participation rates from ethnic minority groups that are often excluded in research protocols (17). We consider that the study population was fairly representative of the main ethnic groups of pregnant women in Oslo. The loss to follow up at gestational week 28 was minor, but 20% did not attend the postpartum visit (17). Most of the mothers initiated breastfeeding, suggesting that mothers in this population were motivated to breastfeed. The high prevalence of gestational diabetes was related to the use of the WHO 2013 criteria, the high proportion of high-risk ethnic groups and universal screening with the oral glucose tolerance test (1).

Our findings may, however, have been affected by the heterogeneity within relatively broad ethnic groups. For example, the South-Asian group included women from Pakistan and Sri Lanka with different breastfeeding prevalences (Appendix S4). Breastfeeding practice was assessed at around 14 weeks of age; thus, the risk of recall bias was probably small. We were, however, not able to assess exclusive breastfeeding according to the WHO definition (21), as the use of plain water was not included in the questionnaire. We do not know whether the supplementation with infant formula in the first week was given before or after hospital discharge. The Stork Groruddalen study was planned before the announcement of the WHO 2013 diagnostic criteria for GDM. We therefore used the WHO 1999 criteria with fasting two-hour glucose values to diagnose GDM according to Norwegian standards at that time. The lack of the one-hour glucose value was therefore a limitation of this study. Similar to prior studies, we relied on self-reported information about weight before pregnancy and gestational weight gain. However, the self-reported weight before pregnancy correlated strongly with measured weight at inclusion in all ethnic groups (1).

CONCLUSION

Our results show that GDM was associated with earlier cessation of predominant breastfeeding. Women who originated from South Asia ended predominant breastfeeding earlier than Western European women, but the association between GDM and breastfeeding was similar in the two groups. The potential of tailored, culture sensitive breastfeeding support to improve breastfeeding rates in these women should be investigated.

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CONFLICT OF INTERESTS

The authors have no conflict of interest to declare.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Appendix S1 Flow chart.
Appendix S2 Risk of cessation of any breastfeeding at or before 18 weeks by history of GDM and other covariates.
Appendix S3 Kaplan-Meier survival curve for predominant breastfeeding by ethnic origin (log rank test p = 0.019).
Appendix S4 Breastfeeding rates in some countries of origin to participants in STORK Groruddalen and in Norway.