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Ethnic differences in postpartum weight retention: a Norwegian cohort study

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Objective To explore ethnic differences in weight retention 14 weeks postpartum.

Design Population-based cohort study.

Setting The STORK Groruddalen Study.

Population A multi-ethnic cohort of healthy pregnant women attending primary antenatal care at three public Child Health Clinics, in Oslo, Norway (n = 642).

Methods An explanatory linear regression was performed to model the relationship between ethnicity and postpartum weight retention. Forward selection of 12 explanatory factors was used to adjust for potential confounding factors, based on univariate analysis and adjusted R^2.

Main outcome measure Postpartum weight retention.

Results Unadjusted mean postpartum weight retention was 2.3 (4.9) kg for women from Western Europe and varied from 3.7 (3.5) to 6.3 (4.7) kg among the five ethnic minority groups. The proportion of women in the highest quintile (postpartum weight retention >8.5–24.4 kg) significantly differed by ethnicity ($P < 0.01$ for the proportion of women from South Asia, the Middle East and Africa compared with Western Europeans). Women from all ethnic minority groups had a higher relative increase in weight from pre-pregnancy to postpartum ($P < 0.01$) compared with Western Europeans. After adjustments for significant exposures, women from the Middle East retained 2.0 kg (95% CI: 1.0–3.0), South Asia 2.8 kg (91.9–3.6), and Africa 4.4 kg (3.1–5.8) more than Western Europeans ($P < 0.01$).

Conclusions Significantly more women with an ethnic origin from South Asia, the Middle East and Africa had high postpartum weight retention compared with Western European women.

Keywords Ethnicity, gestational weight gain, postpartum weight retention.

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Introduction

Pregnancy has been considered a critical period for the development of overweight and obesity. Obesity rates are increasing globally[1,2] and women of Asian and African origin living in Europe are at higher risk for obesity, type 2 diabetes and cardiovascular diseases than the native European population is.[3] Increasing numbers of women enter their pregnancies while overweight or obese,[3] and a high pre-pregnancy body mass index (BMI) elevates risk of maternal and fetal complications, including pre-eclampsia, gestational diabetes mellitus, macrosomia, complicated deliveries, and perinatal morbidity and mortality.[4] A systematic review and meta-analysis found that even a modest increase in maternal BMI was associated with fetal death.[5]

The Institute of Medicine (IOM) recommends that gestational weight gain (GWG) range between 11.5 and 16 kg for women with a normal BMI, while a lower amount of gestational weight gain is recommended for overweight women.[6,7] Women with GWG above recommended levels are at increased risk of postpartum weight retention (PPWR) and therefore are also subject to greater risk of later obesity and related comorbidity such as type 2 diabetes.[8] According to most studies with a follow-up of at least 2.5 years, mean PPWR ranges between 0.4 and 3.8 kg.[8,9] A recent study from the large Norwegian Mother and Child Cohort identified substantial variability in PPWR, and found that among those with initially high PPWR, one group continued to gain weight, whereas another group had a large decline in weight from 6 months to 3 years after birth.[10] Several studies have found that GWG is the strongest predictor of PPWR,[6,11–14] yet PPWR may also be influenced by environmental and other factors before, during and immediately after pregnancy, such as pre-pregnancy BMI,[6] parity and breastfeeding,[15,16] smoking, diet and physical activity habits.[9,16–18] Low educational level[19] and depression during pregnancy[20] have also been associated with higher PPWR. Ethnicity has emerged as a potential important determinant of PPWR, yet research to date remains limited.[9,11] For example, in the only study we identified from Europe, ethnic minority groups from the Middle East had an increased risk of PPWR.[9]

The aim of the present study was to explore ethnic differences in PPWR 3 months postpartum in a population-based cohort of pregnant women living in Oslo, Norway.

Materials and methods

Design, study population and data collection

From May 2008 to May 2010, a total of 823 healthy pregnant women attending primary antenatal care at three public Child Health Clinics (CHC) in Groruddalen, (Oslo) Norway, were included in the study, without any restriction in age.[21] Antenatal care for pregnant women in Norway is carried out in the primary care sector, and pregnant women either receive care at the CHC, at the CHC in combination with a general practitioner (GP), or from the GP alone. GPs were asked to remit pregnant women to the CHC early in pregnancy. Women were included at 15.0 (SD 3.3) weeks of gestation, and had follow-up visits at 28.3 (1.3) weeks of gestation and 14.2 (2.7) weeks postpartum. Groruddalen has a total population of 82 5000 and the CHCs were located in three districts (Stovner, Grorud, Bjerke) which covered affluent as well as more economically deprived residential areas in Eastern Oslo. This area was selected to ensure a high proportion of women with ethnic minority background, and because the majority (75–85%) of pregnant women residing here attend the CHC for antenatal care.[22] Overall, 823 (74%) of invited women participated in the study and of these, 487 (59%) of participants were of ethnic minority origin.[21] For the largest ethnic minority groups, the participation rate was 64–82%, and this study cohort has been found fairly representative for the main ethnic groups of women attending the CHCs for antenatal care.[21] Mean values for age and parity among Western Europeans in the cohort are similar to the mean values for pregnant women in Oslo.[23]

Information material about the study and questionnaires were translated into Arabic, English, Sorani, Somali, Tamil, Turkish, Urdu and Vietnamese and were quality-checked by bilingual health professionals. Women were included if they (1) lived in the district, (2) planned to give birth at one of the two study hospitals, (3) were <20 weeks pregnant, (4) could communicate in Norwegian or any of the above-specified languages and (5) were able to give a written consent to participate. Women with pre-pregnancy diabetes or other diseases necessitating intensive hospital follow-up during pregnancy were excluded. Data from questionnaires and anthropometric measurements were collected by specially trained and certified midwives according to protocol at 15 weeks of gestation, 28 weeks of gestation and 14 weeks postpartum. Professional interpreters assisted with data collection when needed. Study methods have been described in detail elsewhere.[21]

Questionnaire data

The questionnaires were pilot-tested for clarity and feasibility and covered information about demographics, medical history, lifestyle factors and depressive symptoms. Ethnic origin was defined by own country of birth, or that of the participant's mother if she was born outside Europe or North America.[21] Ethnicity was further categorised as Western Europe (primarily Norway, Sweden and Denmark), South Asia (primarily Pakistan and Sri Lanka), the Middle East (primarily Iraq, Turkey, Morocco and Afghanistan), Africa (Somalia was the largest group), East Asia (primarily Vietnam, Philippines and Thailand), and Eastern Europe (primarily Poland, Russia and Kosovo). Women with an ethnic origin from Eastern Europe, Asia, Middle East and Africa are referred to as *ethnic minority* women. Age was used as a continuous variable or categorised according to the median (<30 and ≥30 years). Parity was categorised as either *primiparous* or *multiparous* (≥1). Pre-pregnancy body weight (kg) was self-reported at inclusion. GWG was self-reported at the postpartum visit and used as a continuous variable or categorised as <13 or ≥13 kg, determined by the median. Education was categorised as lower level (<12 years) or higher level (≥12 years). Occupation was recorded with reference to ISCO-88 codes[24] and classified into 10 major hierarchical groups. In the analyses, major groups 1–3 were collapsed into *managers and degree occupations*, major groups 4–8 into *clerical/service and assembly occupations*, and the rest into *elementary occupations and homemakers*. Marital status was classified as *married/partner* or *single*.

The dietary assessment and the evaluation of dietary patterns have been described in detail elsewhere.[25] In brief, the women answered a food frequency questionnaire (FFQ) at

28 weeks of gestation. The FFQ was especially developed for the STORK Groruddalen study to capture dietary habits across ethnic groups and reflected regular intake over the past 2 weeks. The FFQ included 67 food and beverage items, was semi-quantitative and interview-administered by trained study midwives.[25] The FFQ represented major food groups known to be consumed across all ethnic groups. Dietary patterns were extracted using cluster analysis with Ward's method and squared Euclidian distance. Values were not standardised as the distance between values was similar for all variables.[25] We used the less healthy cluster[25] as a dummy variable to reflect an unhealthy dietary pattern.

History of regular physical activity prior to pregnancy was self-reported using the following response categories: never, <1 year, 1–5 years, 6–10 years or >10 years.[26] The response category *never* was recoded into *not regular* and the other categories were merged into *regular* pre-pregnancy physical activity. This variable was used as a proxy for the habitual physical activity pattern. Smoking habits during the 3 months prior to pregnancy were self-reported with the response categories *never*, *light* and *regular*, and recoded into *not smoking* and *regular* smoking. The Edinburgh Postnatal Depression Scale (EPDS) was originally designed to identify women at risk for postpartum depression, but was also used later for depression in pregnancy.[27] The EPDS was used in this study to assess depressive symptoms at 28 weeks of gestation. In accordance with other studies,[28,29] we used EPDS score ≥10 as a proxy measure for depression at 28 weeks of gestation. Mode of delivery was classified as *spontaneous birth*, *vacuum/forceps-assisted* and *caesarean section*. Information about breastfeeding was recorded at the postpartum visit using the response categories *exclusive*, *partial* and *never*, which were recoded into *exclusive* or *not exclusive* breastfeeding during the past 14 days prior to the postpartum visit. The explanatory factors education, pre-pregnancy smoking, pre-pregnancy physical activity and breastfeeding were dichotomised due to none or few observations in some ethnic groups for one or more of the original categories.

Objective measurements of physical activity

At inclusion, participants were asked to wear the accelerometer SenseWear™ Pro_3 Armband for four consecutive days to measure physical activity objectively (Body Media Inc., Pittsburgh, PA, USA). Data from women with a minimum of 1 day (defined as ≥19.2 hours, 80% of the day) of recorded data were included in analysis.[26] Data are reported as mean steps per day or categorised as ≥10 000 or <10 000 steps per day and steps by 1000 per day.

Anthropometric data

Anthropometric measurements included body height (measured to the nearest 0.1 cm using a fixed stadiometer at inclusion) and body weight measured by a Tanita-weight BC 418 MA (Tanita, Tokyo, Japan) at 15 and 28 weeks of gestation and at the postpartum visit.[30] Objectively measured GWG between 15 and 28 weeks of gestation was estimated as the difference between weights at the two time points. Pre-pregnancy BMI was calculated using body height and self-reported pre-pregnancy body weight, and was further categorised as underweight (<18.5 kg/m²), normal weight (18.5–25.0 kg/m²), overweight (25.1–30.0 kg/m²) and obese (>30.0 kg/m²).[6] We further calculated weight loss after delivery by subtracting PPWR from GWG.

Outcome measures

The main outcome variable was PPWR, calculated as the difference between objectively measured weight at the postpartum visit 14 weeks after delivery and the woman's self reported pre-pregnancy weight. Self-reported pre-pregnancy weight was strongly correlated with weight measured at inclusion for all ethnic groups ($r = 0.97$, $P < 0.01$, mean difference: 2.0 kg).[22] PPWR was both used as a continuous variable and divided into quintiles for the whole study population.

Statistical methods

Descriptive statistics are presented by frequencies, mean values, standard deviations (SD) and proportions. All continuous covariates were normally distributed. Comparisons of means were tested by two-sample *t*-tests and chi-squared tests to test differences in proportions for categorical variables. PPWR was reported in absolute and relative (% change in body weight from pre-pregnancy) values. An explanatory linear regression was performed to model the relationship between ethnicity and PPWR. Age and parity were forced in the model, as they were considered established risk factors. The remaining ten explanatory factors (weeks postpartum, GWG, education level, diet, pre-pregnancy BMI, pre-pregnancy physical activity, pre-pregnancy smoking, breastfeeding, depression and mode of delivery) were selected based on univariate analysis of statistical significance with PPWR and high adjusted R^2, according to the method proposed by Blanchet et al.[31] Weight loss after birth was not included in the same model as GWG due to the collinearity between these factors. The potential interaction between age and parity, age and education, pre-pregnancy BMI and parity were probed by addition of interaction terms into the model. The results are presented as regression coefficients (β) with 95% confidence intervals (CI) and accompanied adjusted R^2 (Table 2). Two sets of sensitivity analyses were performed. First, to explore the impact of the choice of method used in the multivariate analysis, we conducted a full model including all 12 explanatory factors, both with and without the interaction terms.

Secondly, self-reported GWG was replaced by objectively measured GWG from inclusion to 28 weeks of gestation and thereafter, weight loss after delivery. *P*-values <0.05 were regarded as statistically significant. SPSS version 20.0 was used for all statistical analysis.[32]

Results

Of the 823 women included at the initial 15-week gestational visit, 662 (80%) attended the postpartum visit and 649 (79%) had valid data on pre-pregnancy and postpartum weight. Women from South and Central America were excluded due to low numbers (n = 7), leaving a final study sample of 642 (78%) women. No significant differences between participants in this study (n = 642) and non-participants (n = 174) were found for age, body height, pre pregnant body weight, pre-pregnant BMI and parity. Slightly more women with low education were found among the non-participants (64% versus 54%, P = 0.02).

We observed differences between ethnic minority women and Western Europeans for parity, education, diet and physical activity ($P < 0.01$ for all). Ethnic minority women were more likely to be multiparous, had lower education and were more likely to report an unhealthy diet. They were less physically active before pregnancy and had fewer objectively recorded steps per day early in pregnancy compared with Western Europeans (Supporting Information Table S1). Women from Eastern Europe had significantly higher mean GWG compared with Western Europeans ($P < 0.05$). Women from Africa and Eastern Europe had significantly higher unadjusted mean GWG at 15–28 weeks gestation compared with Western Europeans ($P < 0.01$). In the total cohort, 18% had a caesarean section.

Mean PPWR was 3.9 kg (SD 5.3) in the total cohort, but differed by ethnicity (Table S1). Relative change in PPWR (% change in weight from pre-pregnancy to 14 weeks postpartum) was significantly higher for each ethnic minority groups versus Western Europeans ($P < 0.01$). The proportion of women in the highest quintile (PPWR >8.5–24.4 kg, unadjusted values) was 12% among Western European, 8% among East Asians, 25% among South Asians, 27% among Middle Eastern, 29% among East European and 41% among African women ($P < 0.01$ for all minority groups versus Western Europeans except for East Asia and Eastern Europe) (Figure S1). Mean weight loss after delivery until the postpartum visit was 9.9 kg (5.2) in the total sample. Women from South Asia, the Middle East and Africa had significantly less weight loss after delivery compared to Western European women ($P < 0.01$).

Postpartum weight retention for categories of 14 potential explanatory factors are presented in Table 1. Significantly higher PPWR was observed among younger women,

Table 1. Postpartum weight retention values for categorical explanatory factors. Mean (SD)

	Total	*P*-value*
Age (years)		
<30	4.7 (5.4)	
≥30	3.1 (5.2)	<0.01
Parity		
Primiparous	3.9 (5.6)	
Multiparous	3.9 (5.1)	0.90
Self-reported gestational weight gain (kg)		
<13	1.2 (4.6)	
≥13	5.9 (4.9)	<0.01
Education level (years)		
≥12	2.8 (5.0)	
<12	4.8 (5.4)	<0.01
Occupational class		
Managers and degree occupations	2.4 (4.5)	
Clerical/service and assembly occupations	4.7 (5.6)	<0.01**
Elementary occupations and homemakers	4.8 (5.7)	<0.01**
Marital status		
Married/partner	3.8 (5.3)	
Single	5.4 (5.6)	0.12
Diet (28 weeks of gestation)		
Healthy	2.9 (5.0)	
Unhealthy	4.4 (5.4)	0.01
Pre-pregnancy BMI (kg/m^2)		
Underweight (<18.5)	6.9 (5.0)	<0.01***
Normal weight (18.5–25.0)	4.2 (4.9)	
Overweight (>25.0–30.0)	3.3 (5.9)	0.09***
Obese (>30.0)	2.5 (5.8)	<0.01***
Pre-pregnancy physical activity		
Regular	3.5 (5.2)	
Not regular	4.2 (5.3)	0.09
Steps per day (15 weeks of gestation)		
≥10 000	3.3 (5.1)	
<10 000	4.0 (5.5)	0.18
Pre-pregnancy smoking		
Not smoking	3.9 (5.3)	
Regular smoking	4.3 (5.4)	0.50
Depression (28 weeks of gestation)		
EPDS ≥10	4.4 (5.7)	
EPDS <10	3.9 (5.3)	0.42
Mode of delivery		
Spontaneous birth	3.8 (5.2)	
Vacuum/forceps-assisted	4.9 (5.7)	0.09****
Caesarean section	3.9 (5.6)	0.77****
Breastfeeding		
Not exclusive	4.1 (5.4)	
Exclusive	3.7 (5.3)	0.42

BMI, Body mass index; EPDS, Edinburgh Postnatal Depression Scale.
*Comparison of means is tested by two sample *t*-test.
**Comparison with managers and degree occupations as reference.
***Comparison with normal weight as reference.
***Comparison with spontaneous birth as reference.

underweight women, women with high GWG, low educational level, unhealthy diet during pregnancy and women with elementary occupations and homemakers, compared with their counterparts. We observed higher PPWR in women with low pre-pregnancy BMI and lower PPWR in women with high pre-pregnancy BMI compared with women with normal weight. For diet, only South Asian women showed an exception to the described patterns, such that those with the healthiest diet had the highest PPWR. For GWG as the exposure, PPWR was slightly higher (0.2 kg) among African women with low GWG (data not shown).

Univariate regression analysis indicated that all ethnic groups (except East Asians) had higher PPWR compared with Western European women (Table 2). When adjusting for age and parity, which were forced into the model, the effect of ethnicity remained quite similar (Model 1). When forward selection method was used, self-reported GWG (Model 2) and education (Model 3) were included as significant explanatory factors. When including GWG in the model, the amount of explained variance increased from 7% (Model 1) to 44% (Model 2) and GWG was thus the most important factor. In the final model, PPWR remained significantly higher for women from South Asia, the Middle East and Africa compared with Western European women (Model 3). The effect of age depended on parity; a small negative association of age among primiparous women (40 g less/year) and a small positive association of age (30 g more/year) was found among multiparous women, although statistical significance was not achieved in all models. For every 1 kg of weight gain during pregnancy, 0.54 kg (95% CI: 0.49–0.59) was retained postpartum. Women with low education level retained 0.74 kg (0.02–1.46) more than highly educated women.

To better illustrate the ethnic differences in PPWR, we estimated PPWR for all ethnic groups based on the average values for the total population as reference values: Western European, 30 years old, low educated, multiparous woman with a GWG of 14 kg (Figure 1).

In the first set of sensitivity analyses, we conducted a full model including all 12 factors. The estimates for ethnicity, age, parity, GWG and education were approximately the same (education lost its significance due to wider confidence intervals), implying that the remaining factors in the full model were not confounding factors. Further, replacing the interaction term with age and parity, as single factors, did not alter the results other than loss of significance of age among multiparous women. In the second set of sensitivity analyses we first replaced GWG based on self-reported data with objectively measured GWG in the second trimester (Model 3); the estimates for ethnicity and other factors remained similar, but adjusted R^2 dropped to 27%. Thereafter, when we used weight loss after delivery instead of self-reported GWG in the model, the estimates for ethnicity were somewhat reduced, but were still significant for all groups except for East Asians, and weight loss after delivery was highly significant. However, the adjusted R^2 dropped to 14%.

Discussion

Main findings

To our knowledge, this is the first population-based European study to assess PPWR in a multiethnic sample, including numerous other relevant potentially explanatory factors. Women from the Middle East, South Asia and Africa had higher mean PPWR compared with women from Western Europe, and at least 25% of women from ethnic minorities had a PPWR of more than 8.5 kg at 14 weeks postpartum. The ethnic differences in PPWR persisted after adjusting for age, parity, GWG and education. Compared with Western European women, mean PPWR was 2.0 kg higher in Middle Easterners, 2.8 kg higher in South Asians and 4.4 kg higher in Africans. GWG explained most of the observed variance in PPWR, with some contribution from education.

Strengths and limitations

The multiethnic, population-based cohort with high participation rates was found to be fairly representative for the main ethnic minority groups living in Oslo and had minor loss to follow-up at 28 weeks of gestation and at birth.[21] The questionnaires were available in eight languages and the use of trained midwives and professional translators familiar with the questionnaires arguably reduced barriers for inclusion of illiterate women. We have a rich, high quality data set for maternal and lifestyle factors, and for ethnic groups not previously studied.[9] Associations between exposures and outcomes in cohort studies are less prone to selection bias than prevalence estimates. Nonetheless, limitations exist due to heterogeneity within relatively broad ethnic groups and low numbers of participants for some groups, and the 20% attrition rate at the postpartum visit. Similar to prior studies,[4,33] we relied on self-reported information about pre-pregnancy weight and GWG. However, the self-reported pre-pregnancy weight correlated strongly with measured weight at inclusion in all ethnic groups.[22] Using measured GWG from 15 to 28 weeks of gestation did not change the final estimates for ethnicity, GWG or education level, lending support to assumptions that self-reported data were fairly valid. The effect of physical activity may be underestimated, as the majority were inactive. The validity of the FFQ has not been formally tested in ethnic minorities but was based on modifications of questions from the original FFQ version previously validated in an ethnic Norwegian population.[25] The FFQ may have captured a larger variance within some ethnic groups than

Table 2. Linear regression of postpartum weight retention (kg) by maternal and socioeconomic factors

Explanatory factors	Univariate		Model 1 n = 642, R^2_{adj} = 0.07	Model 2 n = 620, R^2_{adj} = 0.44	Model 3 n = 619, R^2_{adj} = 0.44
	R^2_{adj}				
Ethnicity	0.07				
Western Europe		Reference	Reference	Reference	Reference
South Asia		**2.8 (1.8–3.8)**	**2.5 (1.4–3.5)**	**3.0 (2.1–3.8)**	**2.8 (1.9–3.6)**
Middle East		**2.8 (1.6–4.0)**	**2.5 (1.3–3.8)**	**2.3 (1.4–3.3)**	**2.0 (1.0–3.0)**
Africa		**4.0 (2.3–5.7)**	**3.7 (1.9–5.4)**	**4.8 (3.4–6.1)**	**4.4 (3.0–5.8)**
East Asia		1.4 (−0.4 to 3.2)	1.3 (−0.48 to 3.1)	1.1 (−0.31 to 2.5)	0.91 (−0.49 to 2.3)
Eastern Europe		**2.9 (1.1–4.8)**	**2.7 (0.85–4.6)**	0.52 (−0.95 to 2.0)	0.45 (−1.0 to 1.9)
Age (years)	0.02	**−0.17 (−0.25 to −0.07)**			
Parity	0.00				
Primiparous		Reference			
Multiparous		0.05 (−0.88 to 0.77)			
Age*parity	0.03				
Age among primiparous		**−0.21 (−0.31 to −0.11)**	**−0.12 (−0.22 to −0.02)**	−0.07 (0.15 to −0.2)	−0.04 (−0.13 to 0.04)
Age among multiparous		0.03 (−0.00 to 0.06)	0.01 (−0.02 to 0.04)	**0.03 (0.01–0.05)**	**0.03 (0.00 to −0.05)**
Weeks postpartum	0.00	0.03 (−0.12 to 0.19)			
Self-reported gestational weight gain (kg)	0.34	**0.51 (0.50–0.60)**		**0.54 (0.49–0.59)**	**0.54 (0.49–0.59)**
Education level (years)	0.03				
≥12		Reference			Reference
<12		**2.0 (1.2–2.8)**			**0.74 (0.02–1.46)**
Occupational class	0.04				
Managers and degree occupations		Reference			
Clerical/service and assembly occupations		**2.1 (1.2–3.1)**			
Elementary occupations and homemakers		**2.2 (1.2–3.3)**			
Marital status	0.00				
Married/partner		Reference			
Single		1.6 (−0.4 to 3.6)			
Diet (28 weeks of gestation)	0.02				
Healthy					
Unhealthy		**1.6 (0.7–2.4)**			
Pre-pregnancy BMI (kg/m^2)	0.02	**−0.15 (−0.23 to −0.06)**			
Pre-pregnancy physical activity	0.00				
Regular		Reference			
Not regular		0.74 (−0.12 to 1.6)			
Steps by 1000 per day (15 weeks of gestation)	0.00	−0.10 (−0.24 to 0.05)			
Pre-pregnancy smoking	0.00				
Not smoking		Reference			
Regular smoking		0.48 (−0.90 to 1.90)			
Depression (28 weeks of gestation)	0.00				

Table 2. (Continued)

Explanatory factors	Univariate R^2_{adj}		Model 1 n = 642, R^2_{adj} = 0.07	Model 2 n = 620, R^2_{adj} = 0.44	Model 3 n = 619, R^2_{adj} = 0.44
EPDS ≥10		Reference			
EPDS <10		−0.52 (−1.8 to 0.8)			
Mode of delivery	0.00				
Spontaneous birth		Reference			
Vacuum/forceps-assisted		1.21 (−0.20 to 2.8)			
Caesarean section		0.16 (−0.93 to 1.3)			
Weight loss after delivery (kg)	0.11	**−0.34 (−0.41 to −0.26)**			
Breastfeeding	0.00				
Not exclusive		Reference			
Exclusive		−0.35 (−1.21 to 0.50)			

BMI, Body mass index; EPDS, Edinburgh Postnatal Depression Scale.
Bold numbers indicate *P*-values <0.05.

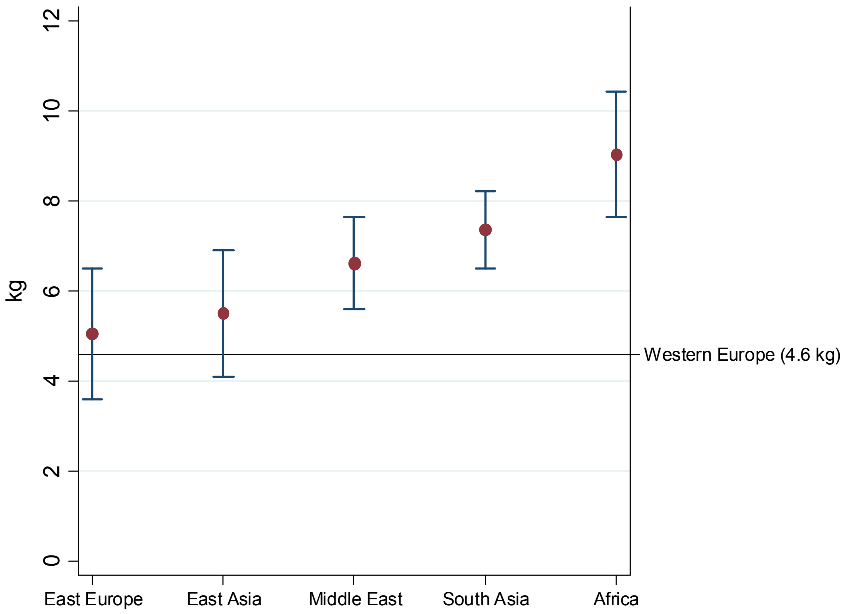

Figure 1. +Estimation of postpartum weight retention for all ethnic groups using Western European, 30-year-old, low educated, multiparous woman with 14 kg gestational weight gain as the reference values. Lines are 95% confidence intervals. Eastern Europe = 5.1 kg, East Asia = 5.5 kg, Middle East = 6.6 kg, South Asia = 7.4 kg and Africa = 9.0 kg.

others. However, all ethnic groups were represented in all four derived dietary patterns; thus, the instrument has arguably provided an assessment of general dietary practices that are less culturally laden. The crude, semi-quantitative FFQ made it impossible to estimate total energy intake, probably the most important aspect for PPWR. We found no indication of selection bias for most explanatory factors, although a slight selection bias was found for education, in line with most similar studies. Lastly, a follow-up at 14 weeks postpartum is a short timeframe to assess PPWR; however, this length of follow-up is comparable to that of a Dutch study.[9]

Interpretation

The strong association between GWG and PPWR in our study is in line with most studies,[8,34–36] although considerable variation in GWG in normal-term pregnancies has been reported.[6] Further, education was also a significant explanatory factor, consistent with a study from UK.[19] In a large cohort study, GWG exceeding IOM recommendations increased the risk of PPWR by more than 2 kg, even after 18 months postpartum.[10] A study investigated weight trajectories 3 years after the index pregnancy to identify subgroups with the highest risk of future obesity.[36] Among the 14% with PPWR >7.5 kg 6 months after birth, 40% had a large decline in weight, whereas 60% continued to gain weight. However, women with low education were underrepresented and very few ethnic minorities were included. Parity has been suggested to be a risk factor for the development of obesity, indicating progressive weight gain in mothers with many children,[3] but results for ethnic differences in PPWR are inconsistent.[37–39] We observed a small positive association of age among multiparous women.

Our study contributes new knowledge, as only one study from Europe has reported ethnic differences in PPWR.[9]

Pre-pregnancy BMI appears to differ between ethnic minority groups in Europe.[3] In our study, pre-pregnancy BMI was significantly related to PPWR in the univariate analysis, but not after adjusting for GWG.

Lifestyle factors such as an unhealthy diet and physical inactivity are strongly linked to type 2 diabetes, obesity and cardiovascular diseases outside pregnancy. Exercise programmes in combination with a healthy diet facilitate weight loss after birth.[40]However, neither objectively measured steps nor regular pre-pregnancy physical activity pattern was significantly associated with PPWR in our study. Dietary habits differ among ethnic groups[41] and, following migration, many alter their traditional diet to a more unhealthy Western diet.[41] Several ethnic minorities reported an unhealthy diet in pregnancy compared with Western Europeans, but dietary pattern was not a significant explanatory factor. The mode of delivery was not found to be significantly related to PPWR, although an operative delivery reduces physical activities for some weeks. Postpartum weight loss may differ by ethnicity,[42,43] but few studies to date have specifically addressed this issue. Mother-care practices in the postpartum period may vary across cultures[41] and different cultural traditions may contribute to variations in postpartum weight loss. We found that 58% of mothers were exclusively breastfeeding their baby at the postpartum visit and only small ethnic differences were observed. This lack of association may be attributed to the short observation period. However, in our study, results from the full model with 12 potentially explanatory factors yielded similar results to the model with only significant predictors. As the estimates for ethnicity did not change after adjustment for physical activity, diet and breastfeeding, all of which were insignificant, these factors did not affect the estimates and were not considered confounding factors in our relatively small study.

Public health implications of our findings relate to the potential long-lasting adverse health effects of high PPWR. Although some women with an initial high PPWR may lose weight later,[36] the high proportion of ethnic minority women in the highest quintile of PPWR is of concern, as women from these groups have higher rates of obesity and diabetes in middle age.[44] Recent meta-analyses of randomised controlled trials from early pregnancy indicate beneficial effects of dietary interventions on gestational diabetes, GWG and PPWR, although not for all outcomes.[45,46] An underused window of opportunity likely exists for routine antenatal care to prevent excessive GWG and related adverse outcomes. Although ethnicity-specific definitions of overweight and obesity have been proposed for Asians outside pregnancy due to their increased risk for obesity-related diseases,[47] the IOM recommendations do not address the need to differentiate GWG according to ethnicity. Our observation that ethnic minority women lost substantially less weight 14 weeks postpartum compared with Western Europeans, indicates the need for further research about cultural practices in this period. In the meantime, promoting a healthy weight gain in pregnancy might be the most important strategy to prevent excessive PPWR, irrespective of ethnic origin. Further, interventions that have been shown effective in the majority population should be culturally adapted to meet the specific needs of pregnant and postpartum high risk ethnic minority groups.[48]

Conclusion

Women from the Middle East, South Asia and Africa had higher risk of PPWR compared with women from Western Europe. High GWG was the most important explanatory factor. Education also contributed.

Disclosure of interests

The authors declare no conflict of interest.

Contribution to authorship

CWW and RSF analysed the data and prepared the tables and figures. CWW wrote the first draft of the manuscript with major contribution from AKJ. RSF, CS, KM, KRR, AB, NS, KIB and AKJ were involved in the revision of the manuscript, and approved the final version.

Details of ethics approval

The study protocol has received ethical approval from the Regional Ethics Committee (2007/894) and the Norwegian Data inspectorate has approved the study protocol. Participation was based on written consent.

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Supporting Information

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

Figure S1. Ethnic differences in postpartum weight retention, % in the highest quintile (>8.5–24.4 kg). Lines are 95% confidence intervals.

Table S1. Characteristics of the cohort stratified into ethnic groups. Mean (SD) or percentages. ■

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