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# Ethnic disparities in maternal obesity and weight gain during pregnancy. The Generation R Study

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ABSTRACT

*Objective:* To examine ethnic disparities in maternal prepregnancy obesity and gestational weight gain, and to examine to which extent these differences can be explained by socio-demographic, lifestyle and pregnancy related characteristics.
*Methods:* In a multi-ethnic population-based prospective cohort study among 6444 pregnant women in Rotterdam, the Netherlands, maternal anthropometrics were repeatedly measured throughout pregnancy. Ethnicity, socio-demographic, lifestyle and pregnancy related characteristics were assessed by physical examinations and questionnaires.
*Results:* The prevalence of prepregnancy overweight and obesity was 23.1% among Dutch-origin women. Statistically higher prevalences were observed among Dutch Antillean-origin (40.8%), Moroccan-origin (49.9%), Surinamese-Creole-origin (38.6%) and Turkish-origin (41.1%) women (all $p$-values $<0.05$). Only Dutch Antillean-origin, Moroccan-origin, Surinamese-Creole-origin and Turkish-origin women had higher risks of maternal prepregnancy overweight and obesity as compared to Dutch-origin women ($p$-values $<0.05$). Socio-demographic and lifestyle related characteristics explained up to 45% of the ethnic differences in body mass index. Compared to Dutch-origin women, total gestational weight gain was lower in all ethnic minority groups, except for Cape Verdean-origin and Surinamese-Creole-origin women ($p$-values $<0.05$). Lifestyle and pregnancy related characteristics explained up to 33% and 40% of these associations, respectively. The largest ethnic differences in gestational weight gain were observed in late pregnancy.
*Conclusion:* We observed moderate ethnic differences in maternal prepregnancy overweight, obesity and gestational weight gain. Socio-demographic, lifestyle and pregnancy related characteristics partly explained these differences. Whether these differences also lead to ethnic differences in maternal and childhood outcomes should be further studied.



## Introduction

Maternal obesity and excessive weight gain during pregnancy are associated with increased risks of preeclampsia and gestational diabetes, stillbirth and premature delivery [1–6]. Also, recent studies suggested that offspring of mothers who were obese during pregnancy or gained excessive weight during pregnancy are at increased risk of an adverse cardiovascular risk profile in later life [2]. The prevalence of maternal obesity is described to differ between ethnic groups [7,8]. In the United States (US), the highest prevalence of maternal prepregnancy obesity has been reported among black women [8]. US studies have also shown that, as compared to white women, black and Hispanic women have a decreased risk of gaining excessive gestational weight according to the Institute of Medicine (IOM) criteria [9,10].

Thus far, most studies on ethnic differences in maternal overweight and obesity have been conducted in the US or the United Kingdom (UK) and were focused on white, black, Asian and

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Hispanic women [9–11]. Less is known about ethnic differences in prepregnancy obesity prevalences and weight gain during pregnancy in other European countries than the UK, which is mainly due to the large variety of ethnic groups in these countries. In the Netherlands, due to colonial and immigrant worker history, the major ethnic groups are Cape Verdean-origin, Dutch Antillean-origin, Moroccan-origin, Turkish-origin, Surinamese-Creole-origin and Surinamese-Hindustani-origin [12,13].

Previously, we have shown that as compared to Dutch-origin women, Cape Verdean-origin and Surinamese-Creole-origin women have an increased risk of gestational hypertensive disorders [14]. Also, mean birth weight was lower in the offspring of Turkish-origin, Cape Verdean-origin, Dutch-Antillean-origin, Surinamese-Creole-origin, Surinamese-Hindustani-origin and Surinamese-other-origin women, as compared to Dutch-origin women [15]. Differences in maternal prepregnancy obesity and excessive gestational weight gain may partly explain these differences in pregnancy outcomes among women from different ethnic minority groups.

Obtaining insight into ethnic differences in maternal prepregnancy obesity and excessive gestational weight gain prevalences is important for the development of future tailored preventive strategies that aim to improve both maternal and fetal pregnancy outcomes.

Therefore, we examined in a multi-ethnic population-based prospective cohort study among 6444 mothers in the city of Rotterdam, the Netherlands, ethnic differences in the risk of maternal prepregnancy overweight and obesity and excessive weight gain during pregnancy. We further explored to what extent these differences can be explained by socio-demographic, lifestyle and pregnancy related characteristics.

## Methods

### *Study design*

This study was embedded in the Generation R Study, a population-based prospective cohort study from early pregnancy onwards in Rotterdam, the Netherlands. The Medical Ethical Committee of the Erasmus Medical Center, Rotterdam, approved the study (MEC 198.782/2001/31). Written informed consent was obtained from all pregnant women. Pregnant women were enrolled between 2001 and 2005 [12]. In total, 8879 pregnant women were enrolled during pregnancy. For the present study, we excluded pregnant women without information on ethnic background, because of the small country specific sample sizes (<100 per group) or mixed ethnicity ($n = 2274$), leading to inclusion of a total of 6605 mothers belonging to one of the major ethnic groups. Furthermore, we excluded pregnant women with pregnancies leading to fetal death, twin pregnancies, and loss to follow-up, because our main interest was in low-risk pregnancies ($n = 156$). Of the remaining 6449 pregnant women, those without any maternal weight measurement available ($n = 5$), were excluded. Thus, the population for analysis included 6444 pregnant women. A participant flowchart is given in Fig. 1.

### *Ethnic background*

Ethnicity was assessed by country of birth of the participating women and their parents and was obtained by questionnaires [12]. Ethnicity was defined according to the classification of Statistics Netherlands. The participant was of non-Dutch origin if one of her parents was born in another country than the Netherlands [16]. If both parents were born abroad, the country of the participant's mother decided on her ethnic background. Next, a distinction was made between women of Dutch ethnic background and the non-Dutch minority groups in this study, Turkish-origin, Moroccan-origin, Dutch Antillean-origin, Surinamese-origin, and Cape Verdean-origin. Since the Surinamese population consists of persons who originate from Africa (Creoles) and India (Hindustani), women with a Surinamese ethnicity were further classified into Surinamese-Hindustani-origin and Surinamese-Creole-origin, based on the ethnic origin of the Surinamese participant [15].

### *Maternal anthropometrics*

Anthropometrics in pregnant women were measured in the first, second, and third trimester of pregnancy at one of the research centers [2]. Height (cm) and weight (kg) were measured without shoes and heavy clothing, and body mass index (kg/m$^2$) was calculated for each pregnancy period. Information about weight just before pregnancy was obtained by questionnaire. As enrolment in our study was in pregnancy, we were not able to measure maternal weight before pregnancy. In our population for analysis, 46.2% of all women were enrolled before a gestational age of 14 weeks. Correlation between prepregnancy weight, obtained by questionnaire, and weight measured at enrolment was 0.95 ($P < 0.001$). No differences in results were found when we used weight measured at enrolment instead of prepregnancy weight obtained by questionnaire. Prepregnancy body mass index was categorized in 4 categories (underweight (<20 kg/m$^2$), normal weight (20–24.9 kg/m$^2$), overweight (25–29.9 kg/m$^2$) and obese (≥30 kg/m$^2$)) [2]. Weight gain until a gestational age of 30 weeks was measured and available for 6148 mothers. Information about weight just before delivery, described as maximum weight during pregnancy in this study, was available in a subgroup of 3016 mothers and was assessed by questionnaire 2 months after delivery. Maximum weight from questionnaire and weight measured at 30 weeks were strongly correlated ($r = 0.97$ [$P < 0.001$]). According to IOM guidelines, we defined excessive gestational weight gain in relation to maternal prepregnancy body mass index (for underweight and normal weight mothers: total weight gain >16 kg; for overweight mothers: total weight gain >11.5 kg; for obese mothers: total weight gain >9 kg [17]). Weight gain was further analyzed in each trimester of pregnancy.

### *Covariates*

We obtained information about maternal age, educational level, household income, marital status, parity and folic acid supplement use at enrolment by questionnaire. Information about maternal diet during pregnancy (total energy intake [kcal]) was obtained by a food frequency questionnaire in the first trimester [2,18]. Information about maternal smoking and alcohol consumption was obtained repeatedly in each trimester of pregnancy. To define maternal smoking and alcohol consumption throughout pregnancy we used information obtained from all three questionnaires. Information on sex, gestational age and weight at birth and pregnancy complications (preeclampsia, gestational hypertension, gestational diabetes, Cesarean delivery) was obtained from medical records. Preterm birth was defined as a gestational age of <37 weeks at birth. Small size for gestational age at birth and large size for gestational age at birth were defined as a gestational age-adjusted birth weight below the 10th percentile and above the 90th percentile in the study cohort.

### *Statistical analysis*

First, we compared maternal characteristics between different ethnic groups, using One-Way ANOVA and Chi-square tests. Second, we used logistic regression models to examine the ethnic differences in the risks of prepregnancy overweight and obesity,