

**Smoking Mothers, Fuming Babies: The effects of maternal smoking on birth weight by mother's country of origin using a multilevel approach**

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**Abstract**

Smoking is one of the most important risk factors in reproductive health in so far as it causes -or exacerbates- important disorders which might compromise reproduction (infertility), pregnancy, and the future newborn's wellbeing. Nicotine obstructs oxygenation and decreases blood circulation through the placenta (González 2005), and it is responsible for complications such as low-lying placenta, placental abruption, premature rupture of membranes, preeclampsia, and low birth weight, among others (Adams and Melvin 1998).

The serious impact that smoking has on health has led to international and national educational and public health campaigns aimed at preventing tobacco consumption in women and to persuade them to give it up when pregnant. Although maternal smoking is currently an important public health issue around the globe, its prevalence and trends vary substantially across countries. The observed between-countries variation has been described within the model of cigarette epidemic, which identifies different phases of the evolution of smoking habits in the population combining information about the overall smoking prevalence in terms of gender and socioeconomic status (Lopez, Collishaw et al. 1994). Within this framework, Sweden is clearly placed in its fourth stage, which is characterized by a continued decline in smoking prevalence (falling in parallel for both sexes) and a major concern on narrowing the existing socioeconomic differences (Moussa, Ostergren et al. 2009).

As far as maternal smoking prevalence is concerned, and as a result of intensive anti-tobacco intervention in antenatal care services (Moussa, Ostergren et al. 2009), Sweden has experienced an important reduction of smoker prevalence at the first antenatal visit (from 31% in 1982 to 10% in 2003). This trend is also extended to the foreign population (from 30% in 1982 to 11% in 2001), even in those groups where in origin the prevalence in the women population is increasing (Moussa, Ostergren et al. 2010). Furthermore, in both immigrants and Swedes, sharp socioeconomic inequalities have been observed which penalize the low educated mothers.

The finding of a convergence pattern among immigrants and Swedes (along with a lower smoking prevalence in some immigrant groups compared with them) and the

existing socioeconomic gradient in the general population have reinforced the concern about narrowing socioeconomic differences, and suggests that there is little interest in studying maternal smoking differentials by mother's country of origin. However, there are still important reasons to do it.

Participation (otherwise, prevalence) does not necessarily capture aspects of the consumption (such as the number of cigarettes per day) (West 2002), which is, however, central to the study of health. In other words, although they show the same general trends, the effects that smoking may have on reproductive health do not have to be the same for all groups of origin.

Developing countries, contrary to most developed ones, are experiencing an increase in the overall prevalence of smoking among women, which is related to the change in the social perception of tobacco and, consequently, in their consumption patterns. This transformation is mainly observed in non-western countries such as India, China, and the Russian Federation, where "westernization" has relaxed the strong taboo against smoking women (West 2002), and where the tobacco industry has found a large market (Mackay and Amanda 2003). So, in this context, it is expected that for certain immigrants (such as the above-mentioned) the consumption might tend to be different and, therefore, have a differential impact on health.

This paper aims to test a different effect of maternal smoking and birth weight depending on the mother's nationality despite their similar individual characteristics. This phenomenon, which expresses a clustering of individual health status within nationalities, might capture a common social contextual environment with different perceptions about the habit of smoking. This paper is focused on birth weight because of its importance in population health in so far as it is a strong predictor of early mortality (Wilcox 2001) and some adult morbidities (Barker 1995), not to mention other significant outcomes such as educational attainment (Onofrio, Singh et al. 2010).

This study may be valuable in providing important findings for public health decisions. Identifying different risk patterns between -and within- groups in the population is essential for the design and implementation of a more precise, and therefore effective, policy making.

## **Data and methods**

This analysis is based on data from the Swedish Medical Birth Register (MBR) for years 2002-2009 (823,553 births), which contains all deliveries in Sweden in this period. This source gathers detailed information of the pregnancy, including the mother's reproductive history and the newborn's outcomes.

Babies who were born alive as singleton births (as it is known that the growth of multiple birth babies is reduced from 33-35 gestational weeks (Adegboye and Heitman 2008)) were selected with available information on weight.

Individual birth weight (in grams) is analyzed by using a multilevel linear regression model, with individuals at the first level and mother's nationality at the second level (more than 100 different countries of origin). The associations between variables were

assessed by using beta coefficient (95% confidence intervals) in the fixed effect part of the models.

Three models are fit. Model 1 does not include any explanatory variables (empty model), focusing on describing only individual and population components of variance in birth weight. In other words, we aim to identify a possible contextual phenomenon that can be quantified by clustering of birth weight within mother's country of origin.

Model 2 is an extension of model 1 studying the association between mother's country of origin and birth weight, including individual information (gestational age, parity, newborn's sex, birth order and height, mother's age, marital status, socioeconomic status, whether mother has suffered from diabetes, hypertension, and/or infections during pregnancy) and using smoking as fixed effects. This model tests whether the association between maternal smoking and birth weight at the mother's national level is explained by the individual composition that characterized each national community (mother's age at birth, or mother's socioeconomic status for example).

Model 3, is an extension of the model 2, where the association between maternal smoking and birth weight varies randomly at the mother's country of origin level (i.e., random slope analysis). This model tests whether the effect of smoking in birth weight is not fixed on the nationality contexts. In other words, whether for some mother's country of origin the effect of smoking on birth weight is stronger than for others.

### **Expected results**

We expect to find different birth weight means for each mother's country of origin group (birth weight cluster effect by mother's nationality) (tested model 1) that is not completely explained by the individual characteristics that describe each community of origin (tested model 2). Therefore, the mother's country of origin being a structural variable to consider when studying the effect of smoking on birth weight. Furthermore, we expect the effect of smoking on birth weight to be stronger in certain nationalities (such as China, India and Russia and others from Eastern Europe) than others (Sweden and other European countries from the UE-15 members).

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