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# Correlation between tobacco control policies and preterm births and low birth weight in Europe

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ABSTRACT

*Objective:* To assess the correlation between tobacco control policies— particularly smoking bans in work and public places—and the prevalence of preterm births and low birth weight in the European countries.

*Methods:* This is an ecological study and the unit of analysis set at the country level. Tobacco control data in Europe were obtained for the years 2010 and 2013 as measured by the Tobacco Control Scale (TCS), which reflects the level of implementation of tobacco control policies. Prevalence data for preterm births and low birth weight were obtained from two sources: the European Perinatal Health Report (EPHR), which provides data for 2010, and the Eurostat data, which includes the years 2013 and 2014. We analyzed the correlation between the TCS score and the prevalence of preterm birth and low birth weight in the European countries by means of Spearman (rsp) rank-correlation coefficients and their 95% confidence intervals (95%CI).

*Results:* The 2010 TCS was negatively correlated with the prevalence of preterm births before week 37 (rsp = −0.51; 95% CI: −0.77, −0.15; p = 0.006) and week 32 (rsp = −0.42; 95%CI: −0.73, −0.01; p = 0.030) and with the prevalence of the low birth weight (< 2500 g, (rsp = −0.42; 95% CI: −0.66, −0.09; p = 0.028) in European countries in 2010. We found a statistically significant inverse correlation between the level of restrictions on smoking in public places and the prevalence of low birth weight (< 2500 g rsp: −0.54; 95%CI: −0.72, −0.10; p = 0.017).

*Conclusion:* The level of smoke-free legislation in European countries correlates with lower preterm birth prevalence rates at the ecological level. Given the important negative effects of premature births for the public health system, these data support greater implementation of smoke-free policies and tend to support the implementation of tobacco control policies, but more research is needed.

## 1. Introduction

Preterm birth is the main cause of infant morbidity and mortality, with approximately 35% of infant deaths attributed to preterm birth; early births have also been implicated in a high percentage of long-term morbidity (Goldenberg et al., 2008; Blencowe et al., 2012; Howson et al., 2013; Shapiro-Mendoza et al., 2016). Preterm birth rates range from 5% to 18%, with wide variability among countries around the world (Blencowe et al., 2012; Kinney and Lawn, 2017). Despite advances in medical care in recent decades, the rate of preterm births has been increasing, even in developed countries (Blencowe et al., 2012; Kinney and Lawn, 2017).

Active smoking and SHS exposure during pregnancy are associated with several adverse effects during reproduction. Smoking during pregnancy has harmful effects on placenta and fetal growth (Mackay et al., 2012) and it has been implicated in several important

*Abbreviations:* TCS, Tobacco Control Scale; EPHR, European Perinatal Health Report; rsp, Spearman rank-correlation coefficients; 95%CI, 95% confidence intervals; SHS, secondhand smoke; CIs, confidence intervals; HDI, Human Development Index; GDP, gross domestic product; NICU, neonatal intensive care unit

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complications, including preterm labor (Nabet et al., 2005; Fantuzzi et al., 2007), intrauterine growth restriction, and low birth weight (Mackay et al., 2012). Moreover, there is a strong association between active smoking during pregnancy and preterm births, with a clear dose-response relationship (Simpson, 1957; Kyrklund-Blomberg and Cnattingius, 1998; Shah and Bracken, 2000; Ko et al., 2014). SHS exposure during pregnancy has also been associated with low birth weight and preterm births (Fantuzzi et al., 2007; Shah and Bracken, 2000; Misra and Nguyen, 1999; Windham et al., 1999; Leonardi-Bee et al., 2008; Crane et al., 2011; Wahabi et al., 2013; Jaakkola et al., 2001).

In the last decade, many countries have implemented tobacco control legislation—particularly smoking bans in work and public places—to protect non-smokers from SHS exposure. Similarly, numerous studies have assessed the impact of smoke-free policies and the benefits of such laws on the health of the population (International Agency for Research, 2017). However, those studies focused on adult populations; there is limited evidence on the impact of smoking legislation in pediatric populations (Dove et al., 2011; Jarvis et al., 2012; Been et al., 2015; Filippidis et al., 2017), particularly with regard to preterm births and birth weight (Been et al., 2015, 2014; Cox et al., 2013; Faber et al., 2008; Vicedo-Cabrera et al., 2016; Bakolis et al., 2016; Simón et al., 2017). According to a recent Cochrane review conducted to assess the impact of legislative smoking bans, the effect of such bans on perinatal outcomes (including preterm birth and low birth weight) cannot be determined based on the available evidence (Frazer et al., 2016).

In this context, we hypothesized that tobacco control policies should reduce tobacco consumption and SHS exposure during pregnancy and thereby also reduce preterm and low weight births after implementation of smoke-free legislation. Nevertheless, evidence on this topic in European countries is scant. Therefore, the objective of the present study was to evaluate the correlation between tobacco control policies—particularly smoking bans in work and public places—and the prevalence of preterm births and low birth weight in the European countries.

## 2. Methods

This is an ecological study with each country as the unit of analysis. Data was obtained from three different sources. We obtained tobacco control data (according to the Tobacco Control Scale; TCS see: http://www.tobaccocontrolscale.org/) in the European countries the years 2010 and 2013 (Joossens and Raw, 2011, 2014, 2006). The TCS provides a score for each country reflecting the level of implementation of tobacco control policies according to six cost-effective policies (Joossens and Raw, 2011, 2014, 2006).

Data on the prevalence of preterm births and low birth weight for the year 2010 were obtained from the European perinatal health report (EPHR) for 28 countries (Committee Euro-Peristat, 2017). The EPHR, published by Euro-peristat, was developed to establish a European perinatal health information system (Committee Euro-Peristat, 2017). We also obtained data on the prevalence of preterm birth and low birth weight in 2013 and 2014 for 14 countries, and in 2015 for 15 countries from the Eurostat. The Eurostat provides statistical information for European countries based on data collected from institutions in the different member countries (Eurostat. Database, 2015).

### 2.1. Variables

#### 2.1.1. Tobacco control policies

We used data from the TCS (Joossens and Raw, 2011, 2014) to quantify the grade and effort of implementation of tobacco control policies in European countries. TCS is a systematic score system developed and drafted by a group of experts in 2006. It had supported from the European Commission and it can be used in more than 30 European countries, more specifically the TCS for 2010 was used in 30 European countries, and the TCS for 2013 was used in 34 European countries (Joossens and Raw, 2011, 2014). The six policies evaluated in the TCS are as follows (with scores shown in parentheses): 1) price increases through higher taxes on tobacco products (maximum 30 points); 2) bans/restrictions on smoking in public and workplaces (maximum 22 points); 3) better consumer information, including public information campaigns, media coverage and publicizing of research findings (maximum 15 points); 4) comprehensive bans on the advertising and promotion of all tobacco products, logos and brand names (maximum 13 points); 5) large, direct health-warning labels on cigarette boxes and other products (maximum 10 points); and 6) treatment to help dependent smokers to quit, including increased access to medications (maximum 10 points). The maximum TCS score is 100 points, indicating full implementation of all strategies.

#### 2.1.2. Gestational age

We used two different sources to obtain the prevalence of preterm birth for 2010, 2013, 2014 and 2015. From the EPHR (Committee Euro-Peristat, 2017), we obtained the prevalence of preterm birth in the year 2010 for 28 European countries. Possible classifications are as follows: < 37 weeks gestational age, < 32 weeks gestational age or < 28 weeks gestational age.

From the EUROSTAT (Eurostat. Database, 2015), we obtained the prevalence of preterm birth for 14 European countries in 2013 and 2014, and for 15 European countries in 2015. In addition, we estimated the mean rate of preterm birth for 2013, 2014 and 2015 using the data extracted from the calculation of the intervals of gestational age ranges according to the number of births in each country in those years. We classified the data as follows: < 37 weeks gestational age, < 32 weeks gestational age, or < 28 weeks gestational age.

#### 2.1.3. Birth weight

We obtained prevalence rates for low birth weight for the years 2010, 2013, 2014 and 2015 from two different sources, as follows: 1) From the EPHR (Committee Euro-Peristat, 2017), we obtained prevalence rates for babies weighing < 2500 g and < 1500 g in 2010 for 28 European countries. 2) From the EUROSTAT (Eurostat. Database, 2015), we obtained the prevalence of births with weights < 2500 g, < 2000 g, < 1500 g, and < 1000 g in 2013 and 2014 for 14 European countries and in 2015 for 15 European countries.

### 2.2. Statistical analysis

We analyzed the correlation between the TCS score in 2010 and the prevalence of preterm birth and low birth weight in European countries in the same year by means of Spearman rank-correlation coefficients (rsp). We also calculated 95% confidence intervals (CIs) for these values. In addition, we analyzed the correlation between each one of the six policies from TCS —particularly bans on smoking in workplaces and public places—and the prevalence of preterm births and low birth weight. We performed these same analyses for the TCS score in 2013 data to determine correlations with the prevalence of preterm birth and low birth weight in the years 2013, 2014 and 2015. Moreover, we performed a simple linear regression analysis between the TCS score or the public place bans score as the independent variable and the prevalence of preterm birth or low birth weight as the dependent variable to test for the statistically significant correlations. Finally, to study differences at socioeconomic level, we stratified the countries to perform the correlation according to countries above and below the median of high gross domestic product (GDP) per capita and human development index (HDI).

## 3. Results

Table 1 shows the data from the TCS and the public place bans policy for the years 2010 and 2013, with the available data on the prevalence of preterm births (< 37 weeks) and low birth weight births