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Perinatal tobacco smoke exposure in 12,405 mother-infant pairs: findings from the EISL Phase 3 in South America

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Abstract

Objective: To determine the prevalence, risk factors for perinatal tobacco smoking, and the effects on infants' respiratory health in 12,450 mother-infant pairs from South America.

Methods: Cross-sectional population-based study in eleven centres from six countries, using a standardised questionnaire completed by parents.

Results: The prevalence of smoking during pregnancy was 8.4%, ranging from 1.4% in Lima to 15.3% in Montevideo; current maternal smoking was 15.3%, from 5.4% in Lima to 34.4% in Santiago; and second-hand tobacco smoke (SHS) at home was 29.8%, from 13.7% in Lima to 50.7% in Santiago. SHS and current maternal smoking were strong and independent risk factors for smoking during pregnancy ($p < 0.0001$). Low maternal education and monthly household income were significant risk factors for perinatal tobacco exposure. The prevalence and severity of wheezing, admissions for wheezing, pneumonia diagnosis, and admissions for pneumonia were significantly higher ($p < 0.0001$) in infants exposed to tobacco smoke.

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Conclusions: The prevalence of smoking during pregnancy, current maternal tobacco smoking, and SHS remain high in South America. Perinatal tobacco smoke exposure is strongly related to greater wheezing severity and a higher prevalence of admissions for wheezing and pneumonia during the first year of life. Low socioeconomic status and low maternal education were the most significant risk factors for smoking during pregnancy, as well as for current maternal smoking and the presence of SHS at home. Our results point to the urgent need to improve the quantity and quality of education against tobacco smoking in girls and families, starting very early in life.

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Introduction

Exposure to tobacco smoke is one of the most critical ongoing epidemics of the 21st century, causing a considerable burden of associated morbidity and millions of deaths annually.¹ Tobacco smoking, directly or indirectly, is responsible for severe acute and chronic diseases, which implies immense expenses for countries' health systems and families.^{1,2} However, one of the worst aspects of tobacco smoking is related to maternal smoking, particularly during pregnancy (prenatal) and postnatal years.³ This is an issue that originated in adolescence, where a high proportion of adolescent girls are current smokers.^{2,4,5} Furthermore, SHS is a frequent and harmful exposure that affects smoking and non-smoking mothers and the respiratory health of their children during prenatal and postnatal life.⁶⁻⁸ Despite the strong and extensive campaigns against SHS, it affects about 60% of children from developing regions of the world.^{4,5,9}

A large body of evidence demonstrates that smoking tobacco during pregnancy and postnatally is the most important environmental exposure that can cause profound and prolonged damage to mothers and infants, with cardiovascular, respiratory, psychiatric, neurological, genetic, and epigenetic effects, and negatively affect breastfeeding duration.¹⁰⁻¹⁸ Despite these well-documented risks, data on the prevalence of perinatal tobacco smoke exposure remain limited in many developing countries. In this context, the present study aims to address this knowledge gap by assessing the prevalence of maternal tobacco use (encompassing current smoking, smoking during pregnancy, and passive household exposure) across eleven urban centres in six South American countries. Furthermore, this study explored the potential associations between perinatal tobacco exposure and the occurrence of recurrent asthma-like symptoms (RALS), pneumonia, and common respiratory viral infections (colds) during the first year of life in infants.

Methods

This study is part of the International Study of Wheezing in Infants Phase 3 (EISL from the Spanish "Estudio Internacional de Sibilancias en Lactantes"), a cross-sectional, population-based study that surveys wheezing and related factors in random samples of infants during their first year of life. The data reported in the present study

were collected in 2012-2014 at 11 centres in six countries in South America: Argentina (Buenos Aires), Brazil (Cuiabá, Curitiba, São Carlos, São José do Rio Preto, São Paulo, Uruguaiiana), Chile (Santiago), Colombia (Bucaramanga), Peru (Lima), and Uruguay (Montevideo). A detailed description of the EISL methodology (questions and definitions) has been published previously.^{19,20} Briefly, EISL uses a standardised questionnaire on wheezing and other related variables that occurred during the first year of life, including protective/risk factors such as prenatal and postnatal tobacco exposure, breastfeeding duration, maternal education, and household income per month, among others, to be responded to by parents of infants 12-15 months of age. Accordingly, all variables included in the analyses were derived from parent-reported outcomes. The questions related to tobacco exposure were as follows: "Do you (the mother) currently smoke tobacco cigarettes?" (current maternal smoking), "Did you smoke tobacco cigarettes during pregnancy?" (maternal smoking during pregnancy), and "Do other people smoke tobacco cigarettes in the house?" (passive tobacco smoking or SHS in the household). Recurrent asthma-like symptoms (RALS) were defined as three or more episodes of wheezing. Infants were considered to have suffered from pneumonia or had been admitted for pneumonia when parents answered positively to the questions: "Has your child had pneumonia or bronchopneumonia?" and "Has your child been admitted for pneumonia or bronchopneumonia?"

The following questions assessed the severity of wheezing: "Has the wheezing or the whistling in his/her chest been so severe (so intense) in the past 12 months that he/she was choking and having real difficulty breathing?"; "Has the wheezing or whistling in his/her chest ever been so severe (so intense) in the last 12 months that you have had to take him/her to an Emergency Department (ED)?"; and "Has your baby ever been hospitalized for wheezing?". Parent-reported monthly household income was used to estimate socioeconomic status at the individual level and was classified as low ($\leq 1,000$ US\$) and high ($\geq 3,000$ US\$). Maternal educational level was classified as low (incomplete primary school), middle (incomplete secondary school), and high (high school diploma, some college, and bachelor's degree).

The centers obtained ethics approval from the local Ethics Committees and funded their study. Parents or guardians who agreed to participate in the study filled in the questionnaire after reading and signing a fully informed written consent.

Data analysis

The proportions of infants whose mothers reported exposure to tobacco smoke (current maternal smoking, maternal smoking during pregnancy, and SHS) among the centers were compared with those without tobacco exposure using the chi-squared test (two-tailed). The Kruskal-Wallis test was used to compare newborn weight and height, as well as weight and height at 12 months of age, between groups of infants exposed and not exposed to perinatal tobacco smoke. An adjusted multivariate logistic regression model (AMLR) was used to estimate the association (OR and 95% CI) of maternal tobacco exposure (current and during pregnancy) with factors such as current employment (yes/no), household monthly income, more than six persons living in the house (yes/no), maternal education, type of delivery (caesarean), and the number of siblings. For infants, AMLR models were used to assess the associations between maternal tobacco exposure (current smoking, smoking during pregnancy, and household SHS) and exclusive breastfeeding for ≥ 4 months; wheezing severity (≥ 7 wheezing episodes, severe episodes, emergency department visits, and hospital admissions for wheezing); ≥ 6 common colds; parent-reported pneumonia; and hospital admissions for pneumonia during the first year of life. Outcomes were selected a priori based on clinical relevance, biological plausibility, and reliable ascertainment in infant surveys, focusing on respiratory outcomes plausibly related to perinatal tobacco exposure, while broader susceptibility or contextual factors (e.g. sex, nursery attendance, mode of delivery, air pollution, parental asthma, pet exposure) were beyond the scope of the present analysis to reduce

the risk of overadjustment and preserve the interpretability of tobacco-specific associations.

The data were analysed using statistical packages, and the results are expressed as mean (95% CI).

Results

Tobacco smoke exposures and corresponding birth weight, birth length, and weight and height at one year of age are shown in Table 1. Current maternal smoking and smoking during pregnancy were related to significantly lower weight and length at birth, and lower weight and height at one year of age. SHS exposure was associated with lower length at birth and lower weight and height at one year of age, but not with lower weight at birth ($p = 0.161$). Questionnaires were completed predominantly by mothers (93.2%), with fathers accounting for 6.8%. The prevalence of tobacco smoke exposure was widely variable among centers, with a mean proportion of smoking during pregnancy of 8.4% (95% CI 7.83-8.80), ranging from 1.4% in Lima to 15.3% in Montevideo, whereas for current maternal smoking, the prevalence was 15.3% (95% CI 14.64-15.90), ranging from 5.4% in Lima to 34.4% in Santiago. The prevalence of SHS exposure at home was 29.8% (95% CI 28.95-30.56), from 13.7% in Lima to 50.7% in Santiago. The prevalence of tobacco exposure by centre is shown in Figure 1.

A high proportion of current smoking mothers (45.1%, 95% CI 42.91-47.39) also smoked during pregnancy, with significant variability among centers, from 9.85% in Lima to 64% in Sao Paulo (Figure 2).

Table 1 Association between tobacco smoke exposure at different time windows and birth weight, birth length, and weight and height at one year of age among 12,405 infants.

	No	Yes	P ^b
Smoking during pregnancy			
Birth length(cm)	48.86 (48.81-48.92)	48.22 (48.02-48.41)	<0.0001
Height at 1 year old (cm)	76.07 (75.96-76.18)	75.43 (75.08-75.78)	0.001
Birth weight (kg)	3.2 (3.19-3.21)	3.08 (3.05-3.12)	<0.0001
Weight at 1 year old (kg)	10.41 (10.38-10.44)	10.29 (10.19-10.39)	0.019
Current maternal smoking			
Birth length (cm)	48.88 (48.82-48.93)	48.44 (48.30-48.58)	<0.0001
Height at 1 year old (cm)	76.07 (75.96-76.18)	75.67 (75.40-75.93)	0.0059
Birth weight (kg)	3.2 (3.19-3.21)	3.14 (3.11-3.17)	<0.0001
Weight at 1 year old (kg)	10.42 (10.39-10.45)	10.3 (10.23-10.37)	0.0029
SHS ^a			
Birth length (cm)	48.85 (48.79-48.91)	48.73 (48.63-48.82)	0.0367
Height at 1 year old (cm)	76.19 (76.07-76.32)	75.58 (75.39-75.77)	<0.0001
Birth weight (kg)	3.20 (3.19-3.21)	3.18 (3.16-3.20)	0.1606
Weight at 1 year old (kg)	10.45 (10.42-10.49)	10.27 (10.22-10.32)	<0.0001

Values are presented as means with 95% confidence intervals.

a: SHS, second-hand tobacco smoke at home; b: independent samples t-test (two-tailed).

Footnote: Birth anthropometrics were analysed in relation to prenatal tobacco exposure, and weight and height at one year in relation to postnatal exposure (current maternal smoking and household second-hand smoke). Comparisons are descriptive and do not imply causal mediation over time.

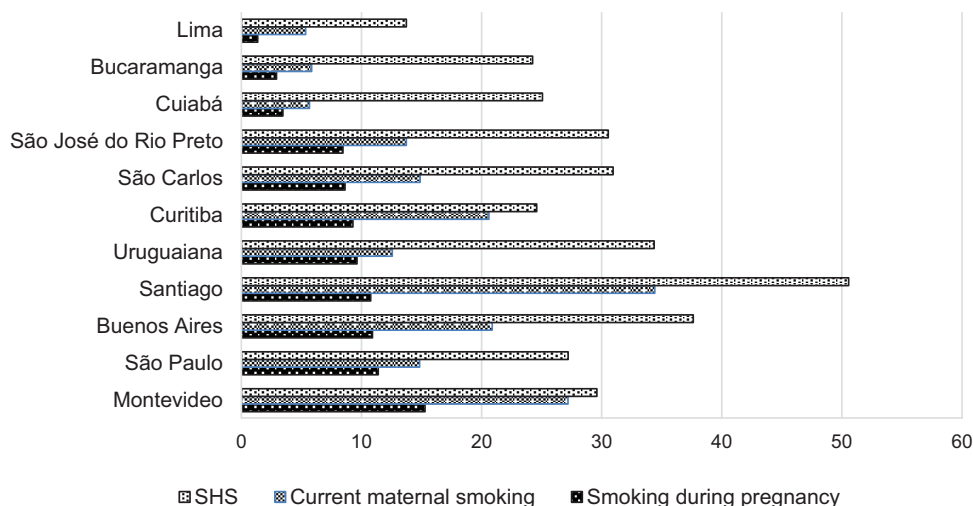


Figure 1 Prevalence (%) of tobacco smoke exposures among 12,405 mother-infant pairs.

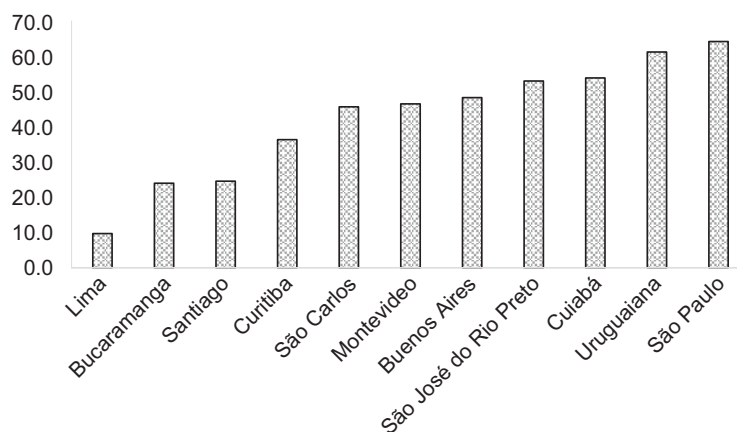


Figure 2 Proportion (%) of current smoking mothers that also smoked during pregnancy, EISL3, n=12,405.

The prevalence of non-smoking mothers exposed to SHS at home was 23.6% (95% CI 22.84-24.46), and 26.3% (95% CI 25.49-27.10) of current smoking mothers who stopped smoking during pregnancy were exposed to SHS at home. In addition, 63.6% (95% CI 61.44-65.77) of current smoking mothers were also exposed to SHS at home.

Associations between perinatal tobacco exposure and duration of exclusive breastfeeding

The proportion of exclusive breastfeeding for ≥ 4 months in those who smoked during pregnancy was significantly lower (62.3%, 95% CI 59.29-65.20) than that in mothers who did not smoke during pregnancy (70.6%, 95% CI 69.77-71.44) ($p < 0.001$). In addition, exclusive breastfeeding for at least 4 months in current-smoking mothers was significantly lower (65.6%, 95% CI 63.42-67.70) than that in those who did not smoke (70.7%, 95% CI 69.82-71.56), $p < 0.001$, whereas in those exposed to SHS at home, the proportion of breastfeeding for at least 4 months was mild but significantly lower (68.4%, 95% CI 66.90-69.90) than that in those not exposed (70.6%, 95% CI 69.59-71.50), $p = 0.010$.

Associations between perinatal tobacco exposure and infant respiratory health

The respiratory outcomes in infants during the first year of life versus tobacco exposure are presented in Table 2. The proportion of infants whose mothers smoked during pregnancy and had RALS during the first year of life was 28.9% (95% CI 26.18-31.71) vs. 15.7% (95% CI 15.01-16.35) in those whose mothers did not smoke during pregnancy ($p < 0.001$). The proportion of RALS in infants of current smoking mothers was 26.3% (95% CI 24.33-28.30) vs. 15.1% (95% CI 14.39-15.75), $p < 0.001$. The prevalence of RALS was significantly higher in those exposed to SHS at home (20.9%, 95% CI 19.62-22.24) vs. those not exposed (15.0%, 95% CI 14.28-15.78), $p < 0.001$.

Tobacco exposure, pneumonia diagnosis, and admission for pneumonia in infants during the first year of life

Logistic regression (stepwise), adjusted by sex, birthweight, socioeconomic status, parental asthma, and maternal

Table 2 Tobacco exposures during pregnancy, current maternal smoking, second-hand tobacco smoke at home, and prevalence (%) of respiratory outcomes in infants during the first year of life.

	Smoking during pregnancy			Current maternal smoking			Second-hand tobacco smoke at home		
	yes	no	<i>p</i>	yes	no	<i>p</i>	yes	no	<i>p</i>
Recurrent asthma-like symptoms (≥ 3 episodes).	28.9	15.7	a	26.3	15.1	a	20.9	15	a
Frequent (≥ 7) wheezing episodes.	9.9	3.9	b	7.6	3.8	ns	6.1	3.7	ns
Severe episode.	32.2	16.2	a	27.2	15.8	a	22.3	15.5	a
Visit to ED for wheezing	42.1	23.2	a	35.4	22.8	a	30.1	22.5	a
Admission for wheezing	18.4	8.1	a	15.4	7.8	a	11.4	7.9	ns
Diagnosis of Pneumonia	22.4	12.3	a	19.3	12.1	a	15.7	12.1	b
Admission for Pneumonia	14.9	7.3	b	12.5	7.1	b	10	7.1	ns

ED: emergency department; a: $p < 0.001$; b: $p < 0.05$; ns: not significant (chi-square).

Table 3 Adjusted odds ratios (95% CI) for the association between tobacco exposure and risk and protective factors.

	Tobacco during pregnancy	Current maternal smoking	Second-hand tobacco smoke at home
High maternal education	0.48 (0.41-0.55)	0.64 (0.57-0.71)	0.75 (0.69-0.82)
Low maternal education	1.54 (1.31-1.80)	1.17 (1.02-1.33)	1.16 (1.04-1.29)
High household monthly income	0.76 (0.66- 0.87)	0.68 (0.61-0.76)	0.86 (0.79-0.93)
Low household monthly income	1.31 (1.15-1.51)	1.47 (1.32-1.63)	1.16 (1.07-1.26)
Employment (yes)	1.05 (0.91-1.21)	1.08 (0.97-1.21)	0.92 (0.85-1.01)
Six or more people living at home	1.02 (0.85-1.22)	1.03 (0.90-1.18)	1.16 (1.04-1.29)
Siblings 2 or more	1.05 (0.90-1.21)	1.07 (0.95-1.21)	0.90 (0.82-0.99)
Day care attendance	1.09 (0.92-1.28)	0.97 (0.86-1.10)	0.91 (0.83-1.00)
Sex (male)	1.05 (0.91-1.20)	1.01 (0.91-1.13)	1.01 (0.93-1.09)

OR: odds ratio and 95% confidence interval.

education, showed that all tobacco exposures in the model were independent and significant risk factors for pneumonia diagnosis during the first year of life ($p < 0.001$): current maternal smoking (OR 1.49; 95% CI 1.29-1.72); smoking during pregnancy (OR 1.67; 95% CI 1.40-2.00); and SHS (OR 1.24; 95% CI 1.10-1.40). However, only smoking during pregnancy predicted admission for pneumonia (OR 1.60; 95% CI 1.28-2.00), $p < 0.001$.

Tobacco exposure and severity of wheezing during the first year of life

The occurrence of ≥ 7 wheezing episodes in the first year of life was significantly associated with maternal smoking during pregnancy (prenatal exposure) and current maternal smoking at 12 months (postnatal exposure) (both $p < 0.001$), but not with reported household SHS exposure. (Table 2). The three tobacco exposures were significant predictors for visiting the ED because of a severe episode of wheezing: smoking during pregnancy (OR 2.33; 95% CI 2.03-2.69), current maternal smoking (OR 1.75; 95% CI 1.56-1.96), and SHS (OR 1.40; 95% CI 1.28-1.54). In turn, all tobacco exposures

significantly predicted admissions for wheezing: smoking during pregnancy (OR 2.30; 95% CI 1.91-2.78), current maternal smoking (OR 2.01; 95% CI 1.72-2.35), and SHS (OR 1.38; 95% CI 1.20-1.59).

The proportion of infants who had ≥ 6 colds during the first year of age was significantly higher in the group whose mothers smoked during pregnancy (33.0%, 95% CI 30.13-35.94) vs. those whose mothers did not smoke (22.0%, 95% CI 21.22-22.76), $p < 0.001$. Similarly, the group of infants whose mothers were current smokers had a higher proportion of ≥ 6 colds (29.1%, 95% CI 27.11-31.25) than those whose mothers were non-smokers (21.8%, 95% CI 20.99-22.59), $p < 0.0001$. Those exposed to SHS at home had a significantly higher proportion of ≥ 6 colds (25.5%, 95% CI 24.12-26.97) than those not exposed to SHS (21.8%, 95% CI 20.93-22.68), $p < 0.0001$.

Risk factors for perinatal maternal tobacco smoke exposure (active or SHS)

Low monthly household income and maternal education level were significant risk factors for smoking during

pregnancy, current maternal smoking, and SHS. Conversely, high maternal education level and high monthly household income were protective factors for the three tobacco exposure types analysed (Table 3). SHS (OR 5.67; 95% CI 4.87-6.64) and current maternal smoking (OR 38.48; 95% CI 31.37-47.20) were strong, independent, significant risk factors for smoking during pregnancy ($p < 0.0001$), after adjusting for household monthly income, maternal education level, number of persons at home, employment, and outdoor air pollution. Among mothers exposed to SHS at home, 19% (95% CI 17.77-20.30) smoked during pregnancy, compared to 3.8% (95% CI 3.39-4.19) among those not exposed ($p < 0.001$).

Discussion

In this large cohort of 12,405 mother-infant pairs, we observed that any exposure to tobacco smoke, whether prenatal or postnatal, was associated with lower birth length and weight, reduced height at 12 months, and an increased risk of respiratory complications during the first year of life. These findings reinforce prior evidence highlighting the early and lasting impact of tobacco smoke exposure on infant growth and respiratory health.^{3,6,12,15,18} However, the association between smoking and infant weight and height at birth and at one year may be confounded by gestational age, infant sex, feeding practices, maternal nutrition, and socioeconomic context. Additionally, we found a high prevalence of tobacco smoking during pregnancy, current maternal smoking, and SHS at home in this South American mother-infant pair cohort, with a high proportion of non-smoking pregnant women exposed to SHS at home.

Prevalence of smoking during pregnancy

Knowing the perinatal prevalence of tobacco smoking exposure is important because it helps guide public health efforts, allocate resources, assess risks to mothers and infants, and develop effective policies and programs to improve maternal and child health. The global prevalence of tobacco smoking during pregnancy, one of the most harmful forms of tobacco exposure, varies widely worldwide. A meta-analysis including data from 174 countries reported prevalences ranging from 0.8% in the African Region to 8.1% in the European Region, with a global estimate of 1.7%; in addition, the highest estimated prevalences were observed in Ireland (38.4%), Uruguay (29.7%), and Bulgaria (29.4%).²¹ However, it should be considered that regional estimates are population-weighted averages that mask marked between-country heterogeneity, explaining why country-specific prevalences in Ireland and Bulgaria exceed the European average. In the present study, Montevideo (Uruguay) was among the South American cities with the highest prevalence of smoking during pregnancy. In a previous study, we found a higher prevalence of smoking during pregnancy in Latin America (9.5%, ranging from 1.7% in Merida to 19.6% in Porto Alegre) and Europe (15.4%), ranging from 9.2% in Zwolle (Netherlands) to 21.0% in Cartagena (Spain).¹⁹ In the present study in South America, the prevalence of smoking during pregnancy was 8.4% and varied from 1.4% in Lima (Perú) to 15.3% in Montevideo (Uruguay),²⁰

showing substantial variability in perinatal smoking prevalence across South American cities, as previously found in Latin American and European centers.^{19,20} The marked difference in smoking during pregnancy between Lima and Montevideo likely reflects broader disparities in adult smoking prevalence, cultural norms, and tobacco-control environments, with Peru's substantially lower smoking rates being historically established.²¹

Current maternal smoking

The estimated global current prevalence of cigarette smoking in women is 17%,²² with 83% of female daily smokers living in countries with a high or very high Human Development Index.²³ Our study found a prevalence of current maternal smoking of 15.3%, ranging from 5.4% in Lima (Perú) to 34.4% in Santiago (Chile), which seems to be in line with the high prevalence of current smoking in female adolescents (24.0%) in Santiago,⁴ where most of these girls will likely continue smoking.

SHS remains a major public health concern for pregnant women, with reported prevalence ranging from 24% to as high as 92% in several Asian countries,²⁴ with notably detrimental health effects for infants, children, and other exposed non-smoking individuals. Although the highly harmful effects of SHS on pregnant women, fetuses, and infants are well documented,²⁴⁻²⁸ SHS often receives less attention, policy implementation, and funding than active smoking, overlooking the widespread and involuntary exposure of nonsmokers, especially in low- and middle-income countries where SHS exposure remains high. A striking finding of the present study was the large proportion (26.3%) of non-smoking pregnant women exposed to tobacco smoke at home. A meta-analysis of serious adverse foetal outcomes in non-smoking pregnant women exposed to SHS showed that they were 23% more likely to experience stillbirth and 13% more likely to give birth to a child with congenital malformations.⁸ Notably, the effect of SHS or active tobacco smoking on the development of asthma or lower lung function might begin before birth,²⁶⁻²⁸ suggesting that tobacco smoking in progenitor lines, particularly in women, might induce epigenetic changes that would mediate complex gene-by-environment interactions causing asthma or lower lung function in children.^{7,11,15,27-29} These studies underscore the persistent prevalence of SHS exposure during pregnancy and highlight the need for targeted interventions to protect future mothers and their unborn children from the harmful effects of SHS exposure.

The substantial variability in smoking prevalence observed across South American cities likely reflects differences in cultural norms, socioeconomic conditions, and the implementation and enforcement of tobacco-control, health, and educational policies; however, the exploration of these contextual determinants was beyond the aims of the present study.

Breastfeeding duration

Tobacco smoke exposure is particularly detrimental to human lactation, which is one of the most critical sources

of nutrition and immunological protection during the first year of life.¹³ We found that any tobacco exposure decreased the duration of breastfeeding for at least 4 months, and the effect was greater in mothers who smoked during pregnancy. It has been shown that SHS exposure is associated with discontinuing any breastfeeding before six months or even earlier;^{13,30} thus, exposed women are more likely to discontinue exclusive breastfeeding than other women.³¹ However, it should be considered that other interrelated factors, such as low socioeconomic and educational status and other smokers in the household, among others, can also affect the duration of breastfeeding.

Respiratory outcomes

Smoking during pregnancy is a critical risk factor for impaired respiratory health in infants, leading to reduced lung function at birth and later in childhood,^{26,28} increased susceptibility to wheezing and lower respiratory infections, and a higher risk of developing persistent asthma in early childhood.^{29,32-35} Our results show a strong deleterious effect of any perinatal tobacco exposure on the respiratory health of infants during the first year of life, particularly smoking during pregnancy, and were associated with a higher prevalence of common viral respiratory infections (colds), more frequent and severe episodes of wheezing, a high prevalence of pneumonia diagnosis, and more admissions for pneumonia and wheezing. However, some potential residual socioeconomic, environmental, or child-care-related confounding cannot be excluded. Beyond its immediate adverse effects in infancy, perinatal tobacco exposure may be associated with longer-term respiratory consequences that could be cumulative and potentially transgenerational.^{18,28,29}

Risks for current maternal smoking and maternal smoking in pregnancy. In this study, in a developing region, low monthly household income (\leq 1,000 US\$) and low maternal education were the most important transversal risks for perinatal smoking exposure, while higher maternal education and household income protected against the three exposures: smoking during pregnancy, current maternal smoking, and SHS. This has also been described in underprivileged populations living in developed regions, where poverty and low education levels are strong predictors of current maternal smoking and smoking during pregnancy.^{36,37-39} Low education level seems to be a modifiable risk factor for perinatal smoking by improving education against tobacco for the entire family, especially for children through early childhood education. Variability in tobacco exposure across centers likely reflects underlying cultural and socioeconomic differences shaping smoking behaviors.⁴

Limitations

The cross-sectional design precludes causal inference and temporal directionality. While a clear association between tobacco exposure and respiratory morbidity is observed, reverse causality and residual confounders remain potential limitations. Our findings demonstrate that tobacco

exposure is associated with lower birth weight and length, adverse effects on breastfeeding duration, a higher prevalence of viral respiratory infections and pneumonia, and greater severity of recurrent asthma-like symptoms during the first year of life. Although not recent, these data provide a unique baseline for perinatal tobacco exposure in the absence of comparable data from the past decade; detailed country-level policy analyses were not within the aims of the present study and are acknowledged as a potential limitation. These results help address the paucity of international data over the past decade regarding major perinatal tobacco exposures and respiratory outcomes affecting mother-infant pairs in the first year of life. Similar detrimental effects of tobacco on the respiratory health of children have been reported in longitudinal studies.^{3,15} The effect of reduced height at 12 months of age in infants exposed to tobacco smoke during pregnancy has not been reported in Latin America and would reflect the significant effect of tobacco during pregnancy and infancy on growth. However, growth outcomes in developing populations are likely influenced by broader contextual determinants, such as maternal undernutrition, anaemia, infections, suboptimal feeding practices, and socioeconomic disadvantages. Our community-based assessment of tobacco smoke exposure in 12,405 infants during the first year of life strengthens existing evidence of its adverse respiratory effects and might align with information suggesting persistence of harm beyond early childhood.^{7,10,12} Another limitation is that the self-reported use of tobacco, alcohol, and other drugs during pregnancy may be flawed because of underreporting. We did not measure cotinine, which may have provided a better or closer idea of the accuracy of self-reported tobacco exposure; however, considering such a large sample, this was impossible because of logistical, financial, and ethical challenges, making such measurements unfeasible. Accordingly, the use of standardized, validated questionnaires remains the most pragmatic and widely accepted approach in large epidemiological studies of this nature. Recall bias represents an inherent limitation of questionnaire-based assessments. Although the survey was conducted when infants were 12 months of age, thereby minimizing the recall period for most post-natal exposures and outcomes, a certain degree of recall bias, particularly in relation to prenatal exposures, cannot be entirely excluded. Regarding the effects of tobacco on reported RALS and other respiratory problems, the lack of physician registration for these events may have limited the findings of this study. The instrument has been validated in Latin America with strong agreement between parental reports and physician-diagnosed RALS;⁴⁰⁻⁴² however, pneumonia, wheezing, and hospital admissions were parent-reported and remain subject to some misclassification. The strengths of the present study include its large, international, multicentre, random population-based sample, high response rate, and use of the same standardised methods in all centers. In addition, this study provides, for the first time to date, international comparative data on the prevalence and risk factors of tobacco exposure affecting the mother-infant pair in South America, an area for which no comparable infant studies have previously been reported. This study highlights the high prevalence of non-smoking mothers exposed to household SHS, affecting 26.3%

of those mothers who stopped smoking during pregnancy and 23.6% of non-smoking pregnant mothers. This reflects the low importance given to SHS as a significantly harmful feature for the foetus and mother and for exposed infants during the first year of life, particularly because SHS is a risk factor that can be modified through education.

Conclusion

Any perinatal exposure to tobacco smoke has strong adverse effects on fetuses and infants during the first year of life. In addition to the effect of tobacco smoke exposure on perinatal growth, this study demonstrated that exposed infants had a higher prevalence and severity of RALS, a higher prevalence of colds and pneumonia diagnoses, and more hospitalizations for wheezing and pneumonia. Furthermore, perinatal exposure to tobacco reduces the duration of exclusive breastfeeding in a substantial proportion of infants. The negative impact of perinatal smoking on offspring respiratory health and breastfeeding underscores the importance of smoking cessation programs for pregnant and new mothers to protect their children's long-term lung health and the quality and duration of breastfeeding. The high prevalence of non-smoking mothers exposed to second-hand smoke at home underlines the critical need for comprehensive and effective smoking cessation programs designed specifically for pregnant women and new mothers.

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Mandatory Disclosure on Use of Artificial Intelligence

The authors declare that no AI-assisted tools were used in the preparation of this manuscript. All references have been manually verified for accuracy and relevance.

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Author Contributions

All authors contributed equally to this article.

Conflict of Interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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