



ORIGINAL ARTICLE

## Impact of parental smoking on childhood asthma<sup>☆</sup>

Francisco-Javier Gonzalez-Barcala<sup>a,\*</sup>, Sonia Pertega<sup>b</sup>, Manuel Sampedro<sup>c</sup>,  
Juan Sanchez Lastres<sup>d</sup>, Miguel Angel San Jose Gonzalez<sup>c</sup>, Luis Bamonde<sup>c</sup>,  
Luciano Garnelo<sup>c</sup>, Teresa Perez Castro<sup>e</sup>, Luis Valdés-Cuadrado<sup>a</sup>,  
Jose-M. Carreira<sup>f</sup>, Jose-D. Moure<sup>c</sup>, Angel Lopez Silvarrey<sup>g</sup>

<sup>a</sup> MD. PhD. Departamento de Enfermedades del Aparato Respiratorio, Hospital Clínico Universitario, Santiago de Compostela, Spain

<sup>b</sup> PhD. Unidad de Epidemiología Clínica y Bioestadística, Complejo Hospitalario Juan Canalejo, Universidade da Coruña, A Coruña, Spain

<sup>c</sup> MD. Departamento de Pediatría, Servicio Galego de Saúde, A Coruña, Spain

<sup>d</sup> MD. PhD. Departamento de Pediatría, Servicio Galego de Saúde, A Coruña, Spain

<sup>e</sup> MD. Facultad de Ciencias de la Salud, Universidade da Coruña, A Coruña, Spain

<sup>f</sup> MD. PhD. Departamento de Radiología, Universidade de Santiago de Compostela, Santiago de Compostela, Spain

<sup>g</sup> MD. PhD. Fundação Maria Jose Jove, A Coruña, Spain

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### KEYWORDS

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### Abstract

**Objective:** To evaluate the exposure to environmental tobacco smoke (ETS) of the childhood population in this community and its relationship with asthma symptoms.

**Methods:** A cross-sectional study was conducted using the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire on children and adolescents in this community. The symptoms "wheezing ever", "current asthma", "severe asthma", and "exercise-induced asthma" were defined by this questionnaire. Parental smoking was classified into four mutually exclusive categories: 1) no parent smokes; 2) only the mother smokes; 3) only the father smokes; and 4) both parents smoke. The odds ratio of the prevalence of asthma symptoms according to ETS exposure was calculated using logistic regression.

**Results:** A total of 10,314 children and 10,453 adolescents were included. Over 51% of the children and adolescents were exposed to ETS at home. ETS is associated with a higher prevalence of asthma symptoms, particularly if the mother or both parents smoke.

**Conclusion:** The prevalence of ETS is still high in this community, although there has been a decreasing tendency in the last 15 years. ETS is associated with higher prevalence of asthma.

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\* Corresponding author.

E-mail: francisco.jaiver.gonzalez.barcala@sergas.es (F.-J. Gonzalez-Barcala).

**PALAVRAS-CHAVE**

Fumaça de cigarro no ambiente;  
Asma;  
Crianças;  
Adolescentes

**Impacto do tabagismo parental sobre a asma infantil****Resumo**

**Objetivo:** Avaliar a exposição da população infantil à FCA em nossa comunidade e sua relação com os sintomas de asma.

**Métodos:** Foi realizado um estudo transversal usando o questionário de estudo ISAAC em crianças e adolescentes da nossa comunidade. Pelo questionário, fez-se a definição por "já ocorreu sibilância", "asma atual", "asma grave" e "asma induzida pelo exercício". O tabagismo parental foi classificado em quatro categorias mutuamente excludentes: 1) nenhum dos pais fuma; 2) somente a mãe fuma; 3) somente o pai fuma; e 4) ambos os pais fumam. Calculou-se a *odds ratio* da prevalência de sintomas de asma, de acordo com a exposição à FCA, usando regressão logística.

**Resultados:** Foram incluídas, no total, 10.314 crianças e 10.453 adolescentes. Mais de 51% das crianças e adolescentes foram expostos à FCA em casa. A FCA se associa a uma prevalência mais alta de sintomas de asma, particularmente se a mãe ou ambos os pais fumam.

**Conclusões:** A prevalência da FCA continua a ser alta em nossa comunidade, embora com uma tendência para diminuição nos últimos 15 anos. A FCA se associa a uma prevalência mais alta de asma.

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**Introduction**

Environmental tobacco smoke (ETS) is associated with a higher prevalence of asthma in adolescents, and with more severe forms in children. Passive exposure to tobacco smoke is common, and its damaging effects on health have been well-known for decades.<sup>1</sup> However, the magnitude of the problem worldwide is poorly described<sup>2</sup>.

Childhood asthma is one of the diseases that most contributes to the health costs arising from passive smoking.<sup>2</sup>

It was estimated that 603,000 deaths were attributable to second-hand smoke in the year 2004, representing 1% of world mortality, of which 28% occurred in children.<sup>2</sup> Although the higher prevalence and severity of childhood asthma due to ETS appears to be well-established,<sup>3-6</sup> other studies report that ETS is not associated with a higher prevalence of asthma in children.<sup>7-9</sup>

The aim of the present study was to analyze the prevalence of asthma symptoms in children and adolescents in this community, according to the passive exposure to smoking by the parents.

**Material and methods**

A cross-sectional study on the child and adolescent population was conducted in the Autonomous Community of Galicia, Spain), following the methodology of the International Study of Asthma and Allergies in Childhood (ISAAC) using a questionnaire, which was previously translated and validated in Spanish.<sup>10,11</sup>

The study was conducted in six of the seven health areas of the region, which included 69% of the total population (1.9 million inhabitants). The schools required to obtain 1,000 valid questionnaires in each age group were randomly selected. All children of 6 to 7 years and 13 to 14 years from each school were included. The schools that declined to participate were replaced with others.

The fieldwork was conducted between October, 2006 and February, 2007. The remaining health area was excluded, as a study was conducted there three years prior, and these results are included in other publications.<sup>10,11</sup>

Permission was requested from the parents or guardians of the children, who also answered the questions in the questionnaire for the 6 to 7 year-old children. The 13 to 14 year-old group completed the questionnaire themselves.

The questionnaire data were entered manually into a database in accordance with the ISAAC protocols, using double entry with subsequent validation.

The environmental questionnaire included questions about asthma symptoms, self-reported height and weight, presence of a dog or cat in the home, parental smoking habits, and maternal education level.

For the purpose of this study, the symptom "wheezing ever" was defined as a positive answer to the question "Has your child ever had wheezing or whistling in the chest at any time in the past?".

The symptom "current asthma" was defined as a positive answer to the question "Has your child had wheezing or whistling in the chest during the last 12 months?".

The symptom "severe asthma" was defined as a combination of the three questions assessing the severity of asthma: "How many wheezing attacks has your child had during the last 12 months?" (none, one to three, four to 12, more than 12); "In the last 12 months, on average how often has your child's sleep been disturbed due to wheezing?" (never, < one night/week, ≥ one nights/week); and "In the last 12 months, has wheezing been severe enough to limit your child's speech to only one or two words at a time between breaths?". Children were considered to have current severe asthma when there were ≥ four asthma attacks or when sleep was disturbed ≥ one nights/week, or when there had been an episode of speech limitation.

The symptom "exercise-induced asthma" was defined as a positive answer to the question, "In the last 12 months,

**Table 1** Prevalence of asthma symptoms.

	6-7 years		13-14 years	
	n	%	n	%
<i>Wheezing ever</i>				
No	6,277	60.9	8,060	77.1
Yes	4,037		2,393	
<i>Current asthma</i>				
No	8,924	86.5	9,083	86.9
Yes	1,390		1,370	
<i>Exercise induced asthma</i>				
No	9,659	93.6	8,382	80.2
Yes	655		2071	
<i>Severe asthma</i>				
No	9,817	95.2	9,849	94.2
Yes	497		604	

All values as number of cases (n) and percentage (%).

has your child's chest sounded wheezy during or after exercise?"<sup>10,12,13</sup>

Parental smoking was classified, based on the responses in the questionnaire, into four mutually exclusive categories: 1) no parent smokes; 2) only the mother smokes; 3) only the father smokes; and 4) both parents smoke.

Obesity and overweight were defined in accordance with the body mass index (BMI) cut-off points set by Cole et al., for each group by age and gender.<sup>14</sup>

The educational level of the mother was classified into three categories: 1) No education or only primary school education; 2) secondary school education; 3) university education.

The study was approved by the Clinical Research Ethics Committee of Galicia.

### Statistical analysis

Multiple logistic regression was used to obtain adjusted prevalence odds ratios (OR) and 95% confidence intervals (95% CI) between asthma symptoms of the schoolchildren and parental smoking. Children whose both parents did not smoke were used as a control group.

In the multivariable analysis the results presented are adjusted for gender, obesity, maternal education level, and cat and dog exposure. Children with incomplete data were excluded from the study. The statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) 17.0 software

### Results

The response rate in the 6 to 7 year-old group was 72.4%, with 10,314 valid cases. The response rate was higher (84.4%, 10,453 cases) in the adolescent group.

The prevalence of asthma in the children's group was 39.1%; of current asthma, 13.5%, severe asthma, 4.8%, and exercise-induced asthma, 6.4%. In the adolescent group these prevalences were 22.9%, 13.1%, 5.8%, and 19.8%, respectively (Table 1).

In the 6-7 year-old group, only the father smoked in 18.8% of the cases, only the mother in 13.1%, both parents in 19.4%, and neither parent smoked in 48.7% of the cases. In the adolescent group, neither parent smoked in 48.4% of the cases, only the father smoked in 18.1%, only the mother in 14.2%, and both parents were smokers in 19.3% of the cases (Table 2).

In the multivariable analysis, parental smoking was associated with a higher prevalence of all forms of asthma in the adolescent population, particularly if the mother, or both parents smoked. The greatest effect was observed for "recent wheezing", with a prevalence OR of 1.42 (95% CI: 1.13-1.79) when only the mother was a smoker (Table 3).

In children, the more significant relationship was with severe asthma, where the prevalence OR was 1.63 (95% CI: 1.22-2.19) when only the father smoked, and 1.67 (95% CI: 1.24-2.25) when both parents smoked (Table 3). In this age group no significant relationship between parental smoking and the symptom wheezing ever was found. Also, no effect when only the mother was a smoker was observed (Table 3).

### Discussion

The results of the present study show that the prevalence of asthma symptoms increases with the exposure to parental smoking, particularly in adolescents. This is in agreement with the majority of published studies, which observe a clear damaging effect of parental smoking on the respiratory health of their children.<sup>2,15,16</sup> Some authors present differing results, showing no significant relationship between ETS and asthma in children.<sup>7-9</sup>

The study by Hatakka included 594 children from 1 to 6 years old, with a low asthma prevalence of 0.9% before 3 years of age, and 5.5% between 4-6 years of age. The small sample size, the age group included, and the low asthma prevalence are factors that can influence the result of an absence of a relationship between ETS and childhood asthma.<sup>8</sup>

A study conducted in Macedonia included 3,026 children aged 13 to 14 years old. This lower sample size used, along

**Table 2** Main characteristics of the children and prevalence of risk factors.

	6-7 years		13-14 years	
	n	%	n	%
<i>Gender</i>				
Male	5,128	50.2	5,116	49.6
Female	5,092		5,204	
<i>Parental smoking</i>				
Neither parent	4,973	48.7	4,991	48.4
Father only	1,918	18.8	1,856	18.0
Mother only	1,345	13.2	1,474	14.3
Both parents	1,984	19.4	1,999	19.4
<i>Obesity</i>				
Normal weight	5,117	67.2	7,246	82.4
Overweight	1,776	23.3	1,362	15.5
Obesity	727	9.5	191	2.2
<i>Cat keeping in the past 12 months</i>				
No	9,387	92.7	8,717	83.9
Yes	736		1,668	
<i>Cat keeping in the first year of life</i>				
No	9,696	94.6	6,586	88.5
Yes	557		855	
<i>Dog keeping in the past 12 months</i>				
No	8,820	87.6	7,409	71.4
Yes	1,252		2,970	
<i>Dog keeping in the first year of life</i>				
No	9,153	89.5	5,935	79.6
Yes	1,074		1,519	
<i>Maternal education</i>				
No education/elementary	2,854	28.1	2,191	21.9
High school	3,871	38.1	4,323	43.2
University	3,433	33.8	3,485	34.9

All values as number of cases (n) and percentage (%).

**Table 3** Odds ratio for prevalence of asthma symptoms according to parental smoking in children and adolescents.

	Wheezing ever OR (95% CI)	Current asthma OR (95% CI)	Exercise-induced asthma OR (95% CI)	Severe asthma OR (95% CI)
<i>6-7 years old</i>				
Neither parent smoke	1	1	1	1
Father only	1.07 (0.94-1.22)	1.20 (1.00-1.43)	1.19 (0.92-1.55)	1.63 (1.22-2.19)
Mother only	1.15 (0.99-1.34)	1.03 (0.83-1.28)	1.10 (0.81-1.49)	1.35 (0.95-1.91)
Both parents	1.14 (0.99-1.30)	1.07 (0.88-1.29)	1.29 (1.00-1.67)	1.67 (1.24-2.25)
<i>13-14 years old</i>				
Neither parent smoke	1	1	1	1
Father only	1.15 (0.97-1.36)	1.22 (0.98-1.51)	1.25 (1.05-1.49)	1.26 (0.92-1.73)
Mother only	1.23 (1.02-1.48)	1.42 (1.13-1.79)	1.34 (1.10-1.63)	1.24 (0.88-1.76)
Both parents	1.27 (1.07-1.50)	1.26 (1.02-1.56)	1.30 (1.08-1.54)	1.40 (1.03-1.90)

CI, confidence interval; OR, odds ratio.

Adjusted by gender, cat and dog keeping, maternal education, and parental smoking.

with the lower prevalence of current wheezing, which was 8.8%, lower than the 13% of the present study's population, could explain the lack of significant relationships between ETS and asthma symptoms. However, a significant association was observed for night-time cough, with a prevalence of 16.5%.<sup>7</sup>

The study by Akçakaya included a population of 2,276 children from 6-15 years. The prevalence of passive smoking was very high, at 67%, but that of asthma was low, showing 7.2% for current wheeze. This low prevalence of symptoms and the lower sample size could explain, at least partially, the lack of effect.<sup>9</sup> It is also well known that the influence of other environmental factors, as well as the different distribution of common risk factors can alter the results.<sup>17</sup>

In the present study it was demonstrated that exposure to parental smoking continues to be high in this community (greater than 51% in both age groups), although a decreasing tendency is observed when compared with another study conducted between 1990 and 1992 with a 6-18 year-old population from the same community, in which the prevalence of parental smoking was 57% for boys, and 55% for girls.<sup>18</sup>

The association between ETS and asthma appears to be stronger in adolescents than in children. Some authors have obtained similar results, with a more consistent relationship in adolescents;<sup>19</sup> others in children;<sup>20</sup> and others have obtained a similar association in both age groups.<sup>21</sup>

In any case, at least part of the differences between the two age groups could be due to the methodology of the ISAAC study, since the parents of the 6-7 year-old children responded, while in the 13-14 year age group, the adolescents themselves completed the questionnaire, which may alter the perception of the symptoms.<sup>22,23</sup>

A stronger association of ETS with asthma was also observed in cases where both parents were smokers, which suggests a possible dose-dependent relationship, in agreement with that mentioned by other authors.<sup>16,18</sup> In the cases of only one parent smoking, the stronger association was with maternal smoking, a fact repeatedly mentioned in the literature. The greater effect of maternal smoking appears to be reasonable, since this negative effect may already have begun in the fetal stage of development; additionally, the relationship of the child with the mother is usually much closer than with the father.<sup>1,15</sup>

Several pathophysiological mechanisms appear to support this harmful effect of ETS on the respiratory system of children. This effect may depend on exposure during pregnancy, since mothers who smoke do not usually give up this habit during pregnancy.<sup>24-26</sup> It is known that smoking during pregnancy affects fetal development and lung maturation, the development of the pulmonary immune system, prematurity, and intrauterine growth retardation, which lead to smaller airways.<sup>1,5,27-29</sup>

After birth, ETS can lead to direct toxicity in the airways, oxidative damage, recruitment of inflammatory cells, increasing neutrophilic inflammation, an increase in epithelial permeability, disposition to respiratory infections, allergic sensitization, poor response to corticoid treatment, and changes in the cytokine profile.<sup>15,30-32</sup>

The present study has some limitations. Due to its cross-sectional design, a causal relationship cannot be established

between ETS and asthma. Also, the data came from a questionnaire, with no objective measurement of exposure to smoking. It is worth mentioning that the validity of questionnaires to evaluate smoking in epidemiological studies is widely contrasted. Several studies have shown a good correlation between smoking evaluated by questionnaire and environmental nicotine levels.<sup>33,34</sup>

The present study's strengths include the large sample of randomly selected children and adolescents included in the study, and the use of the widely validated ISAAC study methodology.

In conclusion, the relationship between ETS and asthma symptoms in children and adolescents in this community appears robust. Likewise, exposure to ETS is common, although it presents a slight decreasing.

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## Conflicts of interest

The authors declare no conflicts of interest.

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