Exposure to secondhand smoke in the home and mental health in children: a population-based study

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ABSTRACT
Objectives To examine the association between exposure to secondhand smoke (SHS) in the home and mental health among children.

Methods Cross-sectional study of 2357 children representative of the Spanish population aged 4–12 years in 2011–2012. Duration of SHS exposure in children was reported by parents. Probable mental disorder was defined as a score >90th centile in the parental version of the Strengths and Difficulties Questionnaire (SDQ). Statistical analysis was performed with logistic regression and adjusted for sociodemographic variables, lifestyle, neighbourhood environment and family characteristics, including parental mental health.

Results Among study participants, 6.9% (95% CI 5.7% to 8.0%) were exposed to SHS in the home for <1 h/day and 4.5% (95% CI 3.5% to 5.5%) for ≥1 h/day. Compared to children not habitually exposed to SHS, the multivariate ORs for probable mental disorder were 1.49 (95% CI 0.85 to 2.62) for SHS exposure <1 h/day and 2.73 (95% CI 1.38 to 5.41) for SHS exposure ≥1 h/day (p for linear trend=0.002). The corresponding ORs for attention-deficit and hyperactivity disorder (ADHD) were 2.18 (95% CI 1.30 to 3.64) for <1 h/day exposure and 3.14 (95% CI 1.63 to 6.04) for ≥1 h/day exposure (p for linear trend<0.001). No association was found between SHS and the rest of the components of the SDQ.

Conclusions Among children, SHS exposure in the home during ≥1 h/day is associated with a higher frequency of mental disorder. This association was mostly due to the impact of SHS on ADHD.

INTRODUCTION
Secondhand smoke (SHS) exposure in children increases the risk of respiratory conditions, otitis media and sudden-death syndrome, among other health problems. Nonetheless, over 10% of children between 5 and 14 years of age in Spain are regularly exposed to SHS in the home.

It is estimated that up to 20% of children and adolescents are affected by mental disorders. Postnatal SHS has been related to worse mental health, but the evidence is inconsistent. In several studies, postnatal SHS exposure has been associated with behavioural disorders and hyperactivity-inattention in children after controlling for prenatal smoking. Also, Hamer et al have reported similar findings for SHS exposure specifically in the home. By contrast, Fergusson et al did not find an association between maternal smoking after pregnancy and behavioural problems after accounting for prenatal maternal smoking.

Likewise, other authors have reported that the association between SHS in the home and the increased risk for conduct problems was mostly explained by prenatal exposure. When it comes to older children, SHS has been linked to mental symptoms in those aged 8–15 years, but the study failed to identify associations with specific diagnoses. However, a recent investigation among adolescents did find a relationship between duration of SHS exposure in the home and psychological distress.

A few studies have examined the relationship between postnatal SHS, and a wide range of mental and behavioural disorders in children of different ages using the Strengths and Difficulties Questionnaire (SDQ), but they failed to reach conclusive results. Finally, although parental mental health has been linked to both smoking and children’s mental health, the single study accounting for parental mental health found maternal smoking during and after pregnancy was independently associated with behaviour problems in children 5 years of age.

Many countries have adopted smoke-free policies; however, these policies do not usually apply to private areas such as homes or vehicles, where most of the SHS exposure in children takes place. Thus, in this study we examined the relationship between duration of SHS exposure in the home and children’s mental health while accounting for parental mental health.

METHODS
Study design and population
Data were taken from the 2011 to 2012 Spanish National Health Interview Survey, conducted on a sample representative of the children’s population in Spain. Study participants were selected on a multistage sampling, stratified according to the size of the municipality. Data were collected using face-to-face interviews from July 2011 through June 2012. The response rate was 71.1% of surveyed households. The members of a total of 13.7% households were absent from their homes, 14.6% refused to participate and 0.7% were unable to participate. Data included interviews from 5495 households with at least one child aged under 15 years; if several children of this age lived in the same home, only one of them was selected at random to participate. Information regarding the participating child was collected from one of the parents or a legal guardian or, if neither were available, another adult.

We excluded 1522 children under 4 years of age since the SDQ is not appropriate for this specific
subgroup. We also excluded 807 children above 12 years of age because experimentation with tobacco products is not unusual at that stage, and any tobacco consumption may confound the SHS-mental health relationship examined. We additionally excluded 701 children whose information was collected from sources other than parents or legal guardians. Lastly, we excluded 108 children with missing data on the variables of interest. Thus, the final analytical sample included 2357 children.

Study variables
Mental health of the child
We evaluated the child’s mental health with the parental version of the SDQ, which has shown good validity and reliability in its original version, as well as in Spanish. The SDQ consists of 25 questions grouped into five subscales: emotional symptoms, conduct problems, hyperactivity-inattention, peer problems, and prosocial behaviour. Each question is scored from 0 to 2 based on the following answers: not true, somewhat true, certainly true. The global SDQ score is calculated as the sum of the first four subscales, ranging from 0 to 40.

Individuals with global or subscale scores above the 90th centile have a substantially raised probability of independently diagnosed mental disorders. As the SDQ scoring system is discrete, cut-off points in either the global or the subscale scores may not match their corresponding 90th centile and, thus, an approximation is used. Thus, we used the cut-off point of the immediately next centile, as in previous studies. 27–29

Secondhand smoke
We assessed SHS exposure by asking the parent or legal guardian how long the child was exposed to tobacco smoke in the home (not habitually exposed (never or only sporadically), <1 and ≥1 h/day).

Potential confounders
We collected information on the child’s sex, age, country of birth (Spain or other), physical activity (playing sports or performing physical activity several times per week) and exposure to SHS outside the home. Adults were also asked their perception of the child’s weight (underweight, normal weight, somewhat overweight, very overweight). Information regarding household structure (two-parent household or not) and parental characteristics (sex, employment status (working or unemployed at time of the interview), educational level (university, vocational training, secondary, primary or no formal studies)) were also collected. Finally, to assess the social class of the family member who contributed the most to household expenses on a regular basis, we used the Spanish Society of Epidemiology classification (I–VI for the highest through the lowest class).

The mental health of the parents interviewed was assessed with the General Health Questionnaire (GHQ-12), validated for the Spanish population. The GHQ-12 consists of 12 questions with four possible answers each. Responses were classified using a binary scoring method, in which the options ‘much less than usual’ and ‘as usual as usual’ received 0 points, and ‘more than usual’ and ‘much more than usual’ received 1 point. The total score ranges from 0 to 12 points and individuals scoring ≥3 were classified as having psychological distress.

Parents classified their smoking status into one of the following categories: “yes, I smoke daily,” “yes, I smoke, but not daily,” “I do not currently smoke but I have smoked before,” “neither I smoke nor I have ever smoked before on a regular basis.” Parents who reported smoking at the time of the interview (either daily or not) were classified as current smokers. Household crowding was defined as residing in a house or flat having <20 m²/person or <1 room/person. Lastly, five neighbourhood environmental risk factors were evaluated by the adult interviewed: nuisance noise, dirty streets, air pollution from a nearby factory, air pollution due to other causes, and delinquency, violence or vandalism in the house or neighbourhood. Each question had three possible answers (none, a little, or a lot) ranging in value from 0 to 2 for an aggregate score from 0 to 10.

Statistical analysis
Data were analysed using logistic regression models. The dependent variable was defined using a score above the 90th centile for the global SDQ or its subscales as the cut-off, and the main independent variable was SHS exposure in the home. Duration of exposure was categorised into three levels using dummy terms: not habitually exposed, <1 and ≥1 h/day. We fitted three logistic models with progressive adjustment for potential confounders. Model A was the crude model. Model B included all potential confounders described above except for parental mental health. Model C further adjusted for parental mental health. The dose–response relationship between SHS and child’s mental health problems was tested with the p for linear trend.

We also examined whether the studied association varied by the sex of the child or of the parent interviewed by using likelihood ratio tests that compared models with and without interaction terms. Finally, a sensitivity analysis was performed by including mother’s tobacco consumption as an additional adjustment in model C. Analyses were performed with Stata V11.0 for Windows (StataCorp, Texas, USA).

RESULTS
Among study participants, 7.7% (95% CI 6.5% to 8.9%) had a probable mental disorder, with a higher prevalence found in children not living in a two-parent household and in children of unemployed parents, with lower education or of lower social class (table 1). Also, 6.9% (95% CI 5.7% to 8.0%) of children were exposed to SHS in the home for <1 h/day and 4.5% (95% CI 3.5% to 5.5%) for ≥1 h/day. Again, SHS exposure was more frequent in children not living in a two-parent household, with unemployed parents or having parents with lower education or of lower social class (table 1).

The proportion of children at a higher risk for probable mental disorders was greater among those whose parents were under psychological distress and had a perception of the child’s weight being either below or above normal. The frequency of probable mental disorders also increased as neighbourhood environmental conditions worsened (table 2). The frequency of SHS exposure at home was greater in children exposed to SHS outside the home (table 2).

Compared to children not habitually exposed to SHS in the home, the OR of a probable mental disorder after adjusting for the main confounders (model B) was 1.61 (95% CI 0.92 to 2.81) in children exposed to SHS during <1 h/day and 3.16 (95% CI 1.63 to 6.12) in those exposed for ≥1 h/day (p for linear-trend <0.001). When adjustment was further made for parental mental health (model C), the corresponding ORs decreased to 1.49 (95% CI 0.85 to 2.62) and 2.73 (95% CI 1.38 to 5.41), p for linear-trend=0.002 (table 3). Results did not vary with the sex of the child (p for interaction=0.871) or with the participating parent (p for interaction=0.700). Further adjustment for mother’s tobacco use slightly reduced the ORs.
**Table 1** Frequency of probable mental disorders* and of levels of exposure to secondhand smoke (SHS) in the home among children 4–12 years of age in Spain, by sociodemographic and clinical variables

| N   | Probable mental disorder % (95% CI) | Not habitually exposed % (95% CI) | SHS <1 h/day % (95% CI) | SHS ≥1 h/day % (95% CI) |
|-----|------------------------------------|----------------------------------|-------------------------|-------------------------|
| Total | 2357 | 88.7 (87.2 to 90.1) | 6.9 (5.7 to 8.0) | 4.5 (3.5 to 5.5) |
| Age (years) | | | | |
| 4–10 | 1842 | 7.8 (6.4 to 9.1) | 89.3 (87.7 to 90.9) | 6.7 (5.4 to 8.0) | 4.0 (3.0 to 5.0) |
| 11–12 | 515 | 7.6 (4.9 to 10.3) | 86.1 (82.5 to 89.7) | 7.5 (4.9 to 10.1) | 6.4 (3.7 to 9.0) |
| Sex | | | | |
| Male | 1222 | 8.6 (6.8 to 10.4) | 89.8 (88.7 to 91.8) | 6.3 (4.7 to 7.8) | 3.9 (2.6 to 5.2) |
| Female | 1135 | 6.8 (5.2 to 8.4) | 87.5 (85.3 to 89.7) | 7.5 (5.7 to 9.2) | 5.1 (3.6 to 6.5) |
| Country of birth | | | | |
| Spain | 2216 | 7.7 (6.4 to 9.0) | 88.6 (87.1 to 90.2) | 6.9 (5.7 to 8.1) | 4.5 (3.5 to 5.5) |
| Other | 141 | 8.1 (3.0 to 13.2) | 88.8 (83.1 to 94.4) | 6.4 (2.4 to 10.4) | 4.9 (0.6 to 9.1) |
| Family structure | | | | |
| Two-parent | 1995 | 7.0 (5.7 to 8.2) | 89.6 (88.0 to 91.1) | 6.5 (5.3 to 7.8) | 3.9 (2.9 to 4.9) |
| Not-two-parent | 362 | 12.1 (8.1 to 16.1) | 83.3 (78.8 to 87.9) | 8.8 (5.5 to 12.1) | 7.9 (4.5 to 11.4) |
| Parental working status | | | | |
| Employed | 1557 | 6.1 (4.7 to 7.4) | 89.7 (87.9 to 91.5) | 6.9 (5.4 to 8.3) | 3.4 (2.3 to 4.5) |
| Unemployed | 800 | 11.0 (8.5 to 13.5) | 86.6 (83.9 to 89.3) | 6.8 (4.8 to 8.8) | 6.6 (4.6 to 8.5) |
| Parental education level | | | | |
| University | 483 | 4.3 (2.2 to 6.5) | 93.4 (90.6 to 96.1) | 5.2 (2.7 to 7.6) | 1.5 (0.2 to 2.8) |
| Vocational training | 554 | 6.9 (4.4 to 9.3) | 90.2 (87.5 to 93.2) | 6.9 (4.4 to 9.3) | 2.8 (1.3 to 4.3) |
| Secondary | 345 | 6.7 (3.6 to 9.8) | 92.5 (89.4 to 95.7) | 4.9 (2.6 to 7.2) | 2.6 (0.3 to 4.8) |
| Primary | 814 | 9.7 (7.4 to 11.9) | 83.3 (80.3 to 86.3) | 8.9 (6.6 to 11.1) | 7.8 (5.6 to 10.0) |
| No formal schooling | 161 | 15.2 (8.9 to 21.6) | 85.5 (79.5 to 91.4) | 6.6 (2.5 to 10.7) | 7.9 (3.4 to 12.4) |
| Social class | | | | |
| Class I (highest) | 309 | 5.9 (2.7 to 9.0) | 93.4 (90.0 to 96.8) | 4.8 (1.9 to 7.6) | 1.8 (0.0 to 3.8) |
| Class II | 201 | 6.0 (2.0 to 10.0) | 92.3 (88.5 to 96.1) | 7.1 (3.3 to 10.8) | 0.6 (0.0 to 1.6) |
| Class III | 505 | 5.9 (3.5 to 8.2) | 91.2 (88.3 to 94.1) | 6.9 (4.2 to 9.5) | 1.9 (0.6 to 3.2) |
| Class IV | 347 | 8.6 (5.4 to 11.8) | 87.9 (83.8 to 91.9) | 7.5 (4.4 to 10.5) | 4.7 (1.9 to 7.5) |
| Class V | 709 | 9.7 (7.2 to 12.2) | 86.4 (83.4 to 89.3) | 6.6 (4.5 to 8.7) | 7.1 (4.8 to 9.3) |
| Class VI (lowest) | 254 | 9.0 (5.2 to 12.8) | 82.0 (76.5 to 87.5) | 10.1 (5.9 to 14.3) | 7.9 (4.0 to 11.8) |
| Don’t Know/No answer | 32 | 7.1 (0.0 to 16.3) | 80.5 (64.6 to 96.4) | 4.5 (0.0 to 13.5) | 15.0 (1.2 to 28.8) |
| Mental disorder | | | | |
| Probable | 182 | 7.7 (6.5 to 8.9) | 77.5 (70.4 to 84.6) | 9.6 (4.9 to 14.4) | 12.9 (6.9 to 18.8) |
| Not probable | 2175 | 92.3 (91.1 to 93.5) | 89.6 (88.1 to 91.1) | 6.6 (5.4 to 7.8) | 3.8 (2.9 to 4.7) |

*According to the Strengths and Difficulties Questionnaire (SDQ).

DISCUSSION

Children between 4 and 12 years of age who were exposed to SHS in the home showed a greater frequency of mental disorder, specifically ADHD, than those who were not exposed or had sporadic exposure only.

The high prevalence of SHS exposure in the home among Spanish children is of public health concern because SHS contains higher concentrations of certain toxic substances than the smoke inhaled by the active smoker. In addition, some of these substances remain in the home environment (on surfaces and as dust particles) for months after tobacco consumption, and may be resuspended in the air or react with other substances creating new pollutants, an exposure that has come to be known as ‘third-hand smoke’. Children are especially vulnerable to ‘third-hand smoke’ exposure, furthermore, the neurological effects of nicotine are greater and longer-lasting in children than they are in adults.

Four previous studies have examined the association between SHS in the home and SDQ-based mental health in children, with inconclusive results. Only Hamer et al. found a positive dose–response relationship between SHS in the home and (1.37; 95% CI 0.76 to 2.46 for <1 h/day exposure and 2.58; 95% CI 1.29 to 5.18 for ≥1 h/day exposure).

Table 4 shows the results of the specific SDQ subscales. Children with any SHS exposure in the home had a higher risk of attention-deficit and hyperactivity disorder (ADHD) than their not habitually exposed counterparts; the OR for <1 h/day exposure was 2.18 (95% CI 1.30 to 3.64) and for ≥1 h/day exposure was 3.14 (95% CI 1.63 to 6.04). Results were similar after adjustment for mother’s tobacco consumption, with an OR of 1.98 (95% CI 1.16 to 3.39) for <1 h/day exposure and 2.95 (95% CI 1.53 to 5.70) for ≥1 h/day exposure. None of the other SDQ subscales showed a statistically significant association with SHS exposure in the home. Lastly, to assess whether the association between SHS and global mental disorder simply contains higher concentrations of certain toxic substances than the smoke inhaled by the active smoker. In addition, some of these substances remain in the home environment (on surfaces and as dust particles) for months after tobacco consumption, and may be resuspended in the air or react with other substances creating new pollutants, an exposure that has come to be known as ‘third-hand smoke’. Children are especially vulnerable to ‘third-hand smoke’ exposure, furthermore, the neurological effects of nicotine are greater and longer-lasting in children than they are in adults.

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between SHS and conduct disorders. In contrast, Rückinger et al. 310 Padrón A, et al. 321 explained away by prenatal exposures. 3

Research

Table 2: Frequency of mental disorders* and level of exposure to secondhand smoke (SHS) in the home among children 4–12 years of age in Spain, by risk factors and environmental variables

|                           | N     | Mental disorder* | Not habitually exposed | SHS <1 h/day | SHS ≥1 h/day |
|---------------------------|-------|------------------|------------------------|--------------|--------------|
|                           |       | % (95% CI)       | % (95% CI)             | % (95% CI)   | % (95% CI)   |
| Physical activity         |       |                  |                        |              |              |
| No                        | 1937  | 7.5 (6.2 to 8.8) | 88.5 (86.8 to 90.1)    | 6.9 (5.6 to 8.2) | 4.7 (3.5 to 5.8) |
| Yes                       | 420   | 8.5 (5.3 to 11.8)| 89.5 (86.2 to 92.9)    | 6.8 (3.9 to 9.7) | 3.7 (1.8 to 5.6) |
| Weight perception         |       |                  |                        |              |              |
| Normal                    | 1876  | 6.7 (5.4 to 8.0) | 89.6 (88.0 to 91.1)    | 6.6 (5.3 to 7.8) | 3.9 (2.9 to 4.9) |
| Underweight               | 235   | 14.1 (9.0 to 19.1)| 86.5 (81.2 to 91.7)    | 6.8 (3.2 to 10.5) | 6.7 (2.6 to 10.8) |
| Somewhat/very overweight  | 246   | 9.0 (5.0 to 13.1)| 83.6 (78.0 to 89.1)    | 9.3 (4.8 to 13.8) | 7.2 (3.4 to 10.9) |
| SHS exposure outside home |       |                  |                        |              |              |
| Yes                       | 12    | 4.0 (0.0 to 13.3)| 27.9 (0.0 to 59.0)     | 29.4 (0.0 to 60.1) | 42.7 (5.7 to 79.7) |
| No                        | 2345  | 7.7 (6.5 to 9.0) | 88.9 (87.5 to 90.4)    | 6.8 (5.6 to 7.9) | 4.3 (3.3 to 5.3) |
| Parental psychological distress |   |                  |                        |              |              |
| Yes                       | 456   | 16.2 (12.1 to 20.3)| 80.7 (76.4 to 85.1)    | 10.5 (7.1 to 13.9) | 8.8 (5.6 to 11.9) |
| No                        | 1901  | 5.8 (4.6 to 6.9) | 90.5 (89.0 to 92.0)    | 6.0 (4.8 to 7.2) | 3.5 (2.4 to 4.4) |
| Household crowding        |       |                  |                        |              |              |
| Yes                       | 1283  | 7.7 (6.1 to 9.4) | 89.0 (87.0 to 90.9)    | 5.9 (4.5 to 7.4) | 5.1 (3.7 to 6.5) |
| No                        | 798   | 6.9 (5.0 to 8.9) | 89.2 (86.8 to 91.6)    | 8.0 (5.8 to 10.1) | 2.8 (1.6 to 4.0) |
| Do not know/no answer     | 276   | 9.3 (5.5 to 13.1)| 86.0 (81.2 to 90.8)    | 8.9 (4.9 to 12.9) | 5.1 (2.1 to 8.1) |
| Neighbourhood environment |       |                  |                        |              |              |
| 0 (best)                  | 1028  | 6.0 (4.4 to 7.6) | 88.9 (86.6 to 91.1)    | 6.8 (5.0 to 8.5) | 4.4 (2.9 to 5.8) |
| 1–2                       | 865   | 8.0 (5.9 to 10.1)| 89.3 (86.9 to 91.6)    | 6.7 (4.8 to 8.5) | 4.1 (2.6 to 5.5) |
| ≥3 (lowest)              | 464   | 10.8 (7.7 to 14.0)| 87.2 (83.6 to 90.0)    | 7.3 (4.5 to 10.2) | 5.5 (2.1 to 7.9) |

*According to the Strengths and Difficulties Questionnaire (SDQ).

Table 3: Association between exposure to secondhand smoke in the home and mental disorders* in children 4–12 years of age in Spain

| Duration of exposure to secondhand smoke in the home | Not habitually exposed <1 h/day | ≥1 h/day | p For linear trend |
|----------------------------------------------------|---------------------------------|----------|-------------------|
| Reference                                           | OR (95% CI)                     | OR (95% CI) |       |
| Model A                                             | 1.68 (0.94 to 3.01)             | 3.94 (2.19 to 7.09) | <0.001 |
| Model B                                             | 1.61 (0.92 to 2.81)             | 2.16 (1.63 to 6.12) | <0.001 |
| Model C                                             | 1.49 (0.85 to 2.62)             | 2.73 (1.38 to 5.41) | 0.002 |
| Sensitivity analysis†                                 | 1.37 (0.76 to 2.46)             | 2.58 (1.29 to 5.18) | 0.007 |

Model A: Crude logistic regression model.
Model B: Adjusted for sex of participating parent, child’s sex, child’s age, child’s country of birth, family structure, parental employment, parental educational level, social class, physical activity, parental perception of child’s weight, exposure to secondhand smoke outside the home, household crowding and neighbourhood environmental factors.
Model C: As model B with additional adjustment for parental mental health.
*According to the Strengths and Difficulties Questionnaire (SDQ).
†Sensitivity analysis: As model C with additional adjustment for mother’s tobacco consumption.

Controlling for many potential confounders such as social class, parental education, family structure and parental mental health, the latter is a potential confounder since it is associated with parental tobacco consumption and, thus, a greater SHS exposure in the home, and because it is also associated with the child’s mental health. Additionally, parents with poorer mental health may have a more negative interpretation of their children’s mental health. Only Williams et al. accounted for this potential confounder in their analysis. In our study, the associations between SHS and mental health in general, and ADHD in particular, were reduced only slightly after adjusting for parental mental health.

The association between SHS in the home and worse mental health outcomes may be explained in part by prenatal exposure to tobacco. Unfortunately, the two exposures are difficult to differentiate since prenatal and postnatal maternal tobacco use are highly correlated. Several studies have found that maternal smoking during pregnancy is associated with behavioural disorders in children. Moreover, in some investigations, the association between SHS in the home and the increased risk for conduct problems was mostly explained by prenatal exposure. In our study, adjusting for postnatal tobacco consumption did not modify the results substantially, but since postnatal maternal tobacco use simply reflects current smoking, we cannot rule out that the observed associations could be partly due to residual confounding (ie, prenatal smoking or other unknown or unmeasured factors). On the other hand, some authors suggest that the association between prenatal tobacco exposure and behavioural problems is influenced by other risk factors in behavioural development such as growing up in disadvantaged conditions and country of birth. Low maternal educational achievement has also been suggested as a potential confounding factor between a child’s mental health and prenatal tobacco exposure. In our analyses, we were able to take all these variables into account,
thus, although there could be some residual confounding from variables not included, we believe the direct association observed between childhood SHS exposure and risk for mental disorders to be robust.

Limitations

Our results should be interpreted in the context of the study’s limitations. First, due to the cross-sectional nature of the data, we were unable to establish causality between SHS exposure in the home and mental health. Second, data were reported by parents, who may provide somewhat biased information. However, there is evidence that the data provided by parents on tobacco consumption in the home are valid estimates of children’s SHS exposure when compared to data from biomarkers.46 Third, it is possible that excluding children whose information was provided by persons other than their parents or legal guardians may have introduced certain selection bias. Fourth, the SDQ for parents is a screening instrument and it does not provide a clinical diagnosis. Still, it has proven a reliable and valid instrument. In addition, values over the 90th centile in the general SDQ as well as SDQ main subscales have proven to be good predictors of risk for mental health disorders.24 Fifth, we had no information on past exposure to SHS. Smoking in the home may have changed during a child’s lifetime, and exposure to SHS in early childhood may be more influential to the children than exposure in later stages of childhood. Sixth, we adjusted for the mental health of only one of the parents. Finally, although we adjusted for a number of potential confounders, we cannot rule out certain residual confounding from unmeasured factors such as the children’s birth weight or the coexistence of other health conditions.

Strengths

Major strengths of this study include the large population-based sample representative of the child population in Spain and analyses adjusted for a wide array of potential confounders. In fact, this is the first examination of the link between SHS in the home and children’s mental health using the SDQ that also adjusts for parental mental health.

CONCLUSIONS

In children, SHS exposure in the home for 1 hour or more per day was associated with a higher frequency of mental disorder, and specifically of ADHD. Longitudinal research confirming these results is needed. Given that legislation in Spain is not directly aimed at reducing SHS exposure in the home, additional actions may be required to reduce children’s exposure to SHS.

Table 4 Association between exposure to secondhand smoke and specific mental disorders* in children 4–12 years of age in Spain

| Duration of exposure to secondhand smoke in the home | OR (95% CI) | p For linear trend |
|-----------------------------------------------------|------------|--------------------|
| Not habitually exposed                               |            |                    |
| Reference                                           |            |                    |
| Emotional symptoms                                  | 1          |                    |
| Conduct problems                                    | 1          |                    |
| Hyperactivity-inattention                            | 1          |                    |
| Sensitivity analysis†                                | 1          |                    |
| Peer problems                                       | 1          |                    |
| Prosocial behaviour                                 | 1          |                    |
| <1 h/day                                            |            |                    |
| 1.18 (0.63 to 2.22)                                 | 1.27 (0.65 to 2.49) | 0.404 |
| ≥1 h/day                                            |            |                    |
| 1.56 (0.86 to 2.83)                                 | 1.28 (0.56 to 2.94) | 0.292 |

*According to the subscales of the Strengths and Difficulties Questionnaire (SDQ).
†Logistic regression model adjusted as model C in table 3.
‡Sensitivity analysis: Sensitivity analysis for hyperactivity-inattention: as model C with additional adjustment for mother’s tobacco consumption.

What this paper adds

- Previous research on the association between postnatal secondhand smoke (SHS) exposure and children’s mental health is inconclusive. Furthermore, past studies using the Strengths and Difficulties Questionnaire (SDQ) have not accounted for the role of parental mental health in this association.
- In a population-based sample of 4–12 year-olds in Spain, we showed a significant and substantial dose–response association between SHS exposure in the home and a higher frequency of global mental problems, measured with SDQ. Unlike most previous findings, our results were adjusted for parental mental health.
- SHS exposure for even less than 1 h per day was also associated with a higher frequency of attention-deficit and hyperactivity disorder. However, no association was found between SHS and the rest of the components of the SDQ. Thus, the association between SHS and global mental problems was mostly due to the impact of SHS on the attention-deficit and hyperactivity disorder.

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