

Early smoking in school-aged children with and without a diagnosis of asthma

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Background: Research has shown that adolescents with asthma are as likely as and sometimes even more likely to smoke than their peers without asthma. The current study examined whether the prevalence of the first active smoking experience differs for children (9–12 years of age) diagnosed with asthma compared with children who do not have asthma. The association between asthma and smoking was evaluated with logistic regression analysis, controlling for socio-economic status, parental smoking and child's internalizing and externalizing behaviours. **Method:** A nation-wide sample of 1476 mother and child dyads participated, of which 220 children (14.9%) had been diagnosed with childhood asthma. **Results:** Children diagnosed with asthma were 2.45 times more likely to have taken a puff of a cigarette compared with children without asthma. In addition, the association between asthma and early smoking remained significant after including potential confounders in the regression equation. **Discussion:** Suggestions are provided for preventing school-aged children, especially youths with asthma, from smoking. Additional research is needed to gain further insights into the mechanisms underlying the higher likelihood of early smoking among children with asthma.

Introduction

Cigarette smoking has serious detrimental effects on individuals' health. For individuals with asthma, smoking causes even greater adverse health consequences. In addition to long-term health consequences, noticeable short-term effects include increased respiratory symptoms, airway inflammation, reduced lung function and impaired response to asthma medication.¹ One might expect that children and adolescents with asthma would be less likely to jeopardize their health by taking up smoking than their peers without asthma. However, research has indicated that—particularly during adolescence—individuals with asthma are more likely to smoke than their peers without asthma.² These findings require more insights into the developmental process of regular smoking habits, especially regarding this at-risk group. In developing such insights, it is important to control for factors that relate to both childhood asthma and children's smoking. For instance, it has been well established that parental smoking increases the odds for children's smoking;³ it also increases the likelihood of incidence and progression of asthmatic symptoms in children.⁴ Socio-economic status (SES) is also associated with both smoking⁵ and asthma,⁶ although the direction of the relationship between SES and asthma might depend on the status of asthma⁶ (i.e. prevalence vs. hospitalizations). Finally, researchers have found that childhood behavioural problems are risk factors for smoking,⁷ and evidence also suggests that children with asthma have elevated levels of internalizing and externalizing behaviours.⁸ Therefore, the present study will control for these factors while examining early smoking behaviours among children with and without asthma. Previous research comparing smoking among adolescents with and without asthma has focused primarily on regular smoking habits. Such research has determined that the development of smoking progresses through different stages.⁹ Young people begin experimenting with smoking at ~10 years of age;¹⁰ however, scholars have not yet adequately investigated early smoking experiences among children with asthma. Rather, most studies have included older samples and measured early smoking

retrospectively,^{11–13} which could lead to biased recall responses.¹⁴ To avoid recall biases, researchers should measure the age of onset as close to the actual age of onset as possible. The present study examined early smoking (i.e. taking a puff of a cigarette) among a sample of 9- to 12-year-old children, with and without asthma. Including children of this age provides the opportunity to examine the stage during which the first puff of a cigarette occurs. As a consequence, this minimizes the possibility that asthma is a consequence of active smoking. Information is required about the earliest stage of active smoking in this at-risk group in order to develop effective programmes targeting at preventing smoking among children with asthma. The present study is the first to focus on differences between children with and without asthma in their first experience of active smoking. Whereas most studies concentrate on children in adolescence, we examined an age group that starts to become interested in smoking but generally do not engage in regular smoking yet. Since this is the first study to focus on this younger age group, it has an explorative character.

Methods

Procedure and participants

Baseline data were obtained from a randomized controlled trial that evaluated a home-based smoking prevention programme in The Netherlands entitled Smoke-free Kids¹⁵ (see Hiemstra *et al.*¹⁶). Baseline data were collected prior to randomization. Primary schools in central and southern parts of the country were approached in order to contact parents. Parents could enrol in the programme by returning a recruitment letter. Inclusion criteria included: (i) participation of the mother or female guardian and one 9- to 12-year-old child per family and (ii) both participants were competent in reading and speaking Dutch. Information of mothers and children was obtained via telephone interviews and questionnaires. Children could only answer closed-ended questions to protect against parents who—against our instructions—listened to their child during the telephone interview. For the paper questionnaires, two envelopes were included so children and mothers

were able to return their own questionnaires without seeing each other's answers.

Measures

SES

SES was measured using the educational level of both parents. This variable was assessed using a 9-point scale covering all education levels. Participants were allocated to lower, middle or higher education groups and then the educational levels of the father and mother were combined: 0 = both parents lower or one lower and one middle; 1 = both middle or one lower and one higher and 2 = both parents higher or one middle and one higher.

Parental smoking

To assess parents' smoking status, a 9-point scale was used with options ranging from 'I have never smoked, not even a puff' to 'I smoke at least once a day' (see also¹⁷). Mothers indicated which option applied to themselves as well as to the biological father of the child. The variable was coded as 0 = both parents are non-daily smokers; 1 = one parent is a daily smoker and 2 = both parents are daily smokers.

Child problem behaviours

Problem behaviours were measured with the problem scales (i.e. emotional problems, hyperactivity, conduct problems and peer relationships) of the Dutch parent version of the Strength and Difficulties Questionnaire (SDQ),^{18,19} a screening tool for clinical assessment of mental disorders and epidemiological research. Subscales consisted of five items with response options 0 = not at all; 1 = a little, sometimes and 2 = very much, all the time. A sum score was calculated for each subscale with higher scores implying more problems.

Asthma: diagnosed asthma

Asthma was indicated if mothers responded 'yes' to the questions: 'Does your child have had asthma?' and 'Did a physician confirm that your child has asthma?' McGill *et al.*²⁰ confirmed the validity of parental reports of physician-diagnosed asthma in a random subsample with a 98.5% conformation rate of physicians' reports.

Asthma: current symptoms

The parent version of the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire was used to screen for asthma.^{21,22} Mothers indicated how often symptoms were present in their children in the 12 months prior to the study. They were also asked to indicate the most recent time their children experienced asthma symptoms. All children with diagnosed asthma were divided into two groups: 0 = past asthma (last symptoms longer than 12 months before measurement) or 1 = current asthma (symptoms at present or within the 12 months preceding the measurement).

Children's early smoking

Children were asked a 'yes' or 'no' question concerning whether they had ever smoked (a cigarette), even if it was only a puff.¹⁵

Statistical analysis

First, differences between children with and without asthma were assessed with Pearson's chi-square for the categorical variables (children's gender, SES and parental smoking); means and mean differences [with 95% confidence interval (95% CI)] are shown for continuous variables (age and problem behaviours), assessed using *t*-tests. Second, logistic regression was used. Results are reported as

odds ratios (OR's with 95% CI) for early smoking for children with and without asthma. These logistic regressions were adjusted for the effects of age, gender, parental factors and children's problem behaviours. This procedure was replicated within the subsample of children with asthma to examine whether children with current asthma were more at risk for early smoking compared to children with past symptoms of asthma. All analyses were performed using SPSS version 15.0.

Results

In total, 1476 mothers and their children participated. Children's mean age was 10.12 years (SD = 0.78); 47.8% were boys. In 98.6% of the families, the biological mother participated and almost all mothers and children were of Dutch nationality (98.2%).

Almost 15% of the children had been diagnosed with asthma by a physician (table 1). Children with diagnosed asthma were slightly older and comprised of significantly more boys than those not diagnosed. Moreover, children with asthma demonstrated higher scores on emotional problems [mean difference = 0.49, 95% CI = 0.18–0.79, *t* (1474) = –3.13, *P* = 0.002]. Total scores for hyperactivity and conduct problems were only marginally different whereas peer relationships, SES and parental smoking behaviour were similarly distributed within the non-asthmatic and asthmatic groups.

Early smoking and asthma

Of the total sample, 5.4% of children reported having puffed on a cigarette. The unadjusted OR's for early smoking indicated that children with asthma were 2.45 times more likely to have smoked than children without asthma (95% CI = 1.48–4.07, table 2). Within the asthmatic and non-asthmatic groups, 10.5% and 4.5% reported having smoked a puff of a cigarette, respectively. Children with two smoking parents were most at risk to have smoked, followed by children with one smoking parent. Furthermore, higher rates of hyperactivity and conduct problems were associated with early

Table 1 The study population displayed by number of participants (percentage) for child's gender, parental SES and parental smoking and by means (SDs) for child's age and problem behaviour

	Non-asthmatics <i>n</i> = 1256 (%)	Diagnosed asthma <i>n</i> = 220 (%)	<i>P</i> -value
Gender: male, <i>n</i> (%)	574 (45.7)	131 (59.5)	<0.001
SES ^a , <i>n</i> (%)			0.56
Low	314 (25.8)	62 (29.2)	
Middle	323 (26.5)	55 (25.9)	
High	580 (47.7)	95 (44.8)	
Parental smoking ^b , <i>n</i> (%)			0.60
Both non-smoker	861 (68.8)	148 (67.6)	
One smoker	269 (21.5)	45 (20.5)	
Both smoker	121 (9.7)	26 (11.9)	
Problem behaviour (mean ± SD)			
Hyperactivity	2.99 ± 2.71	3.40 ± 2.98	0.06
Emotional problems	2.28 ± 2.10	2.76 ± 2.26	0.002
Conduct problems	1.00 ± 1.28	1.19 ± 1.56	0.07
Peer relationships	1.20 ± 1.53	1.34 ± 1.63	0.19
Age (mean ± SD)	10.10 ± .77	10.22 ± .84	0.04

a: Does not add up to 1476 due to 6 missing values on mother's educational level; 39 missing values on father's educational level (among which 12 cases in which no father figure was present); 2 cases with missing values on both educational levels

b: 28 cases in which no father figure was available were considered as non-smoker, interpreted as lacking a smoking father as a model figure. Further, 3 missing values on mother's smoking and 3 missing values on father's smoking

smoking behaviours. Including these confounders in the regression equation lowered the odds for early smoking among asthmatic children; however, the association of asthma with early smoking remained significant (OR=2.09, 95% CI=1.18–3.70). While predicting early smoking with asthma status at Step 1 accounted for 2% of the variance in early smoking, adding all study variables at Step 2 explained 15% of the variance of early smoking.

Current vs past asthma

In total, 97 mothers (43.9%) reported that their child had experienced wheezing in the chest within the 12 months preceding the study. For 18 of these children, wheezing was so severe that they were limited in their ability to speak to only one or two words at a time between breaths. Furthermore, 85 children (38.5%) had experienced a dry cough at night within the 12 months preceding the study. Based on mothers' indication of time since the most recent episode of asthma symptoms, the subsample was divided into two groups: (i) having had symptoms in the past (42.5%) and (ii) currently experiencing asthma symptoms (48.9%). Some mothers ($n=19$, 8.6%) could not accurately indicate whether asthma symptoms were present during the 1 year before baseline; reasons included co-morbidities such as hay fever and eczema, amongst others. These children were not included in the analysis predicting early smoking. Of note, none of the 19 children excluded had ever puffed on a cigarette.

For children with past symptom asthma, 34.0% of the parents belonged to the lower SES group, 20.9% belonged to the middle SES group and 45.1% belonged to the higher SES group, compared with 26.0, 27.9 and 46.1%, respectively, for the current symptom group. For parental smoking behaviour, 61.3% of children with past symptom asthma had non-smoking parents, 23.7% had one smoking parent and 15.0% had two smoking parents, compared with 71.3, 19.4 and 9.3%, respectively, in the current symptom group. Neither SES ($P=0.36$) nor parental smoking ($P=0.32$)

distributions significantly differed between past and current asthma symptom children.

For hyperactive behaviour, children with current asthma had marginally higher scores than symptom-free children [mean difference = -0.81 , 95% CI = $-1.64 - 0.01$, $t(199) = -1.95$, $P = 0.052$]. No differences in mean scores were observed for emotional problems ($P = 0.48$), conduct problems ($P = 0.67$) or peer relationships ($P = 0.53$). A regression equation including these confounders revealed similar odds for early smoking among children with current or past asthma (table 3). Solely including asthma severity status did not explain any of the variance in predicting early smoking; however, including all study variables at Step 2 explained 36% of the variance of early smoking.

Discussion

The present study aimed to scrutinize the association between asthma and the first stage of active smoking in primary school children while controlling for confounding factors related to asthma and smoking. In line with literature indicating higher rates of regular smoking among adolescents with asthma,² we found that 9- to 12-year-old children with physician-diagnosed asthma were more than twice as likely to have had a smoking experience compared to their peers without asthma. Not all studies concentrating on stages prior to regular smoking found an increased risk of smoking among adolescents with asthma. Concerning the age at which children smoked their first cigarette, based on self-reports of 15-year-olds with and without asthma, Hublet *et al.*¹¹ found no difference in onset. Precht *et al.*¹² also concluded, in a sample of 15- to 20-year-old adolescents, that adolescents with and without asthma started smoking regularly at the same time (14.6 vs. 14.8 years of age); however, more boys with than without asthma smoked

Table 2 Logistic regression analysis predicting early smoking by asthma, while adjusting for age, gender, SES, parental smoking, hyperactivity, emotional problems and conduct problems

Variable	OR (95% CI)
Unadjusted: Step 1	
Asthma	
No asthma (Ref.)	1
Asthma	2.45** (1.48–4.07)
Adjusted: Step 2	
Age	1.24 (0.92–1.69)
Gender	
Girls (Ref.)	1
Boys	1.13 (0.68–1.90)
SES	
High (Ref.)	1
Middle	1.04 (0.53–2.04)
Low	1.53 (0.83–2.80)
Parental smoking	
Both non-smokers (Ref.)	1
One smoker	2.86** (1.42–5.76)
Both smokers	3.28*** (1.86–5.77)
Child problem behaviour	
Hyperactivity	1.13*** ^a (1.03–1.24)
Emotional problems	1.06 (0.95–1.19)
Conduct problems	1.19*** ^a (1.01–1.40)
Peer relationships	1.01 (0.86–1.18)
Asthma	
No asthma (Ref.)	1
Asthma	2.09* (1.18–3.70)

$n=1421$ in the adjusted model. Ref.=Reference category. * $P<0.05$, ** $P<0.01$, *** $P<0.001$.

a: OR's for child health behaviour represent the increase in the risk of early smoking per unit increase of the variables

Table 3 Logistic regression analysis predicting early smoking by current asthma status, while adjusting for age, gender, SES, parental smoking, hyperactivity, emotional problems and conduct problems within the subsample of children with diagnosed asthma

Variable	OR (95% CI)
Unadjusted: Step 1	
Current asthma	
Past symptoms (Ref.)	1
Current symptoms	0.91 (0.40–2.27)
Adjusted: Step 2	
Age	0.87 (0.47–1.59)
Gender	
Girls (Ref.)	1
Boys	1.78 (0.54–5.88)
SES	
High (Ref.)	1
Middle	1.03 (0.20–5.32)
Low	1.81 (0.49–7.22)
Parental smoking	
Both non-smokers (Ref.)	1
One smoker	3.40 (0.76–15.13)
Both smokers	6.13** (1.59–23.94)
Child problem behaviour	
Hyperactivity	0.97 (0.79–1.18)
Emotional problems	1.18 (0.90–1.56)
Conduct problems	1.71*** (1.18–2.48)
Peer relationships	1.06 (0.73–1.54)
Current asthma	
Past symptoms (Ref.)	1
Current symptoms	0.83 (0.28–2.47)

$n=192$ in the adjusted model. Ref.=Reference category. ** $P<0.01$

a: OR for child health behaviour represents the increase in the risk of early smoking per unit increase of this variable

regularly before the age of 14 years. Finally, Van de Ven *et al.*¹³ concluded that adolescents with asthma were less likely to have experimented with smoking between the age of 12.9 and 14.8 years, although once they began smoking, they progressed to regular smoking more quickly.

The focus of the present study was to measure the very first experience of active smoking in a younger sample than usually. Most researchers assess the age of onset during middle or late adolescence, which can cause recall bias. The present sample of 9- to 12-year-old children is believed to minimize recall bias. As described by Engels and colleagues,¹⁴ recall bias in smoking assessment increases as the interval between smoking onset and the time of recall is longer. For instance, in their 5-year longitudinal study,¹⁴ respondents aged 12.4 years at baseline estimated their age of smoking onset during all three waves. At the first wave, mean reported age of smoking onset was 10.52 years; at the third wave the same respondents reported a mean age of onset of 12.42. Thus, inconsistencies in smoking behaviour preceding regular smoking may be caused by recall bias due to the age of the study cohort at which this behaviour was retrospectively assessed. Furthermore, both Hublet *et al.*¹¹ and Precht *et al.*¹² included only those adolescents who had already smoked whereas the present study also included children that may not progress to regular smoking.

The relationship between asthma and smoking remained significant after controlling for important confounders. With respect to gender, we did not find significant effects. One reason may be that our study only had few girls with asthma who reported having ever smoked a puff. Another reason may be that our sample was too young: gender differences in any tobacco use were also not found at age 12/13 years in Hedman *et al.*,²³ but were present in 14- to 15-year olds.

Parental smoking was similarly distributed within the asthmatic and non-asthmatic groups. This may indicate that parents of children with asthma do not adjust their smoking behaviours to their children's health condition, which was also found elsewhere.^{3,11} In addition to the heightened risk for early smoking among children with smoking parents, parental smoking is especially harmful for children with asthma via second-hand smoke, which can worsen asthma by accelerating the decline of lung functioning, increasing asthma severity, lowering quality of life and diminishing response to medication.⁴

The final confounder was childhood problem behaviour. Children with diagnosed asthma demonstrated more emotional problems and marginally significantly more hyperactivity and conduct problems than children without asthma. Although smoking is associated with internalizing and externalizing behaviours,⁷ findings did not support the relationship of asthma and early smoking to be explained by these behaviours. Generally, the SDQ is a reliable tool in screening childhood psychological well-being.^{18–19} However, Stone *et al.*¹⁹ also noted the need for caution when using a single informant report on the SDQ as the report may not generalize to outside the parents' home. Therefore, we suggest that the present study be replicated in a clinical sample to examine whether children with asthma with more pronounced internalizing or externalizing problems will engage more in early smoking.

Asthma was measured through self-reported diagnosis, which has been found to be reliable.^{20,22} The changeable pattern of symptoms characteristic of asthma²⁵ might require a more detailed, in-depth subdivision to reveal more precisely which children are most at risk for smoking. We attempted to do so by examining current asthma symptoms. One might expect children who experience respiratory difficulties to refrain from engagement in behaviours, which could harm their health. However, our findings do not support this idea. In fact, they indicate that children currently experiencing asthma symptoms experiment with cigarette smoking by taking a puff of a cigarette as often as symptom-free asthmatic children.

In addition to examining whether current symptoms play a role, the specific factors that trigger a child's asthma may also be of importance to smoking onset, especially when controlling for psychological problems.

Strengths, limitations and implications

This study had several strengths. In addition to a large sample size, the time of measuring early smoking is of great importance. Almost all scholars have investigated the first stages of smoking retrospectively.^{2,11–13,24} The current study examined early smoking at an age at which it was most likely to occur. However, some limitations should be noted. First, our study was cross-sectional, providing the first step in examining early smoking behaviour in children with asthma. However, smoking develops in different stages, and empirical evidence supports different risk factors of the various stages of smoking.⁹ Longitudinal designs provide greater insights into the development and risk factors of smoking in both asthmatic and non-asthmatic children. Adolescents with asthma have been found to accelerate to regular cigarette use after trying cigarettes¹³ and to eventually smoke more cigarettes per day, but with more quit attempts¹² than adolescents without asthma.

Second, our recruitment of families via schools may have had implications for several study variables. First, most diagnosed children reported experiencing mild asthma. It would be interesting for future research to focus on distinct groups of children with asthma, to examine exactly which children are at a higher risk to start smoking since this atopic disease varies in phenotype, with great individual variability over time.²⁵ In addition, our sample included mostly families with relatively high SES levels. The total number of children who had smoked a (puff of a) cigarette could potentially have been higher when including lower SES families. Although our data do not show an increased risk of SES in early smoking, lower SES generally is associated with higher smoking rates.⁵ Also, SES can be associated with the other study variables as described in the introduction section. For instance, parents in lower SES families are more likely to smoke and children in lower SES families may be more at risk to have asthma. Moreover, low SES has also been linked to psychopathology, which has been shown to affect smoking.

Finally, existing studies suggest that smokers react differently to questionnaire surveys with smokers being late- or non-responders.²⁶ Therefore, smoking parents may be underrepresented in the current sample in which we approached parents to participate only once. However, parental smoking rates are similar to national statistics.²⁷ As is often the case with surveys, we do not have data on non-responders and it is therefore hard to speculate about whether or not smoking parents with or without a child with asthma were more reluctant to respond. However, an underestimation might have occurred with smoking parents of children with asthma being less willing to enrol in the study (e.g. because of feelings of guilt²⁸).

The finding that 9- to 12-year-old children with asthma do engage in smoking can be very important for the treatment of asthma. Physicians should be aware of the risks of taking up smoking in children and adolescents with asthma, even when asthma symptoms are present and substantial. As such, active smoking should be discussed during consults with this age group. Smoking prevention can be accomplished at the family level. Special programmes could be developed to help parents prevent their child from smoking,¹⁵ possibly through educational programmes and increasing awareness of available prevention programmes (e.g. via general practitioners or school doctors).

Conclusion

This study investigated early engagement in active smoking among children with and without a diagnosis of asthma. The disturbing finding that children with asthma were twice as likely to have

smoked (a puff of) a cigarette requires more research in the near future.

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Conflicts of interest: None declared.

Key points

- Active smoking experience is already an issue of concern for 9–12 year olds.
- More children with a diagnosis of asthma than without have smoked (a puff of) a cigarette.
- This effect could not be explained by well-known confounding factors for either smoking or asthma (e.g. SES, parental smoking and children's problem behaviour).
- The prevention of smoking should start during the primary school period, focusing special attention on accessing families of children with a history of asthma.

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