

Effects of active tobacco smoking on the prevalence of asthma-like symptoms in adolescents

Javier Mallol
 José A Castro-Rodriguez
 Eliana Cortez

Department of Pediatric Respiratory Medicine, Faculty of Medical Sciences, Hospital CRS El Pino, University of Santiago de Chile, Santiago, Chile.

Abstract: The prevalence of asthma in adolescents markedly varies between different localities as found by the International Study of Asthma and Allergies in Childhood (ISAAC) and this may be due to environmental factors. Although tobacco smoke exposure is related to an increase in the prevalence of asthma, there is lack of information on that respect in children from developing countries, where active tobacco smoking usually starts early in adolescence. This study was undertaken to assess the effect of tobacco smoking on the prevalence of asthma symptoms in a random sample of 4738 adolescents aged 13.4 ± 1.05 years who responded the ISAAC video questionnaires plus questions on tobacco smoking. The prevalence of tobacco smoking in the last 12 months was 16.2%, with significant female predominance. The persistent smokers had a significantly higher prevalence of asthma-like symptoms ever and in the last 12 months (wheezing, wheezing with exercise, nocturnal wheezing, severe wheezing, and dry nocturnal cough) than ex-smokers and nonsmokers. More than 27% of asthma symptoms in our adolescents are attributable to active tobacco consumption (population attributable risk). This study strongly suggests that potent and more effective campaigns against tobacco smoking should be implemented in developing countries, where active tobacco smoking is dramatically increasing in children.

Keywords: asthma, prevalence, ISAAC, tobacco, video questionnaires.

Introduction

Asthma is the more frequent chronic pulmonary disease in childhood and as reported by the International Study of Asthma and Allergies in Childhood (ISAAC) its prevalence notoriously varies between countries and also between different localities in the same country (ISAAC 1998; Mallol et al 2000). The mentioned global variability in asthma prevalence has been found to occur when using written and video questionnaires (Crane et al 2003) and it is probably related to the characteristic and magnitude of environmental factors present in surveyed areas. It is well known that atmospheric pollution, viral respiratory infections, burden of inhaled allergens, and tobacco smoke inhalation, among others, could significantly alter asthma prevalence and its clinical expression (Chilmonczyk et al 1993; DiFranza and Lew 1996; Just et al 2002; McConnell et al 2002; Preutthipan et al 2004; Jartti et al 2004; Morgan et al 2004; Koenig et al 2005). Exposure to tobacco smoke, either passive or active, has been demonstrated to increase the prevalence of asthma, asthma severity, bronchial responsiveness, and other related respiratory diseases in children (Young et al 1991; Chilmonczyk et al 1993; Agabiti et al 1999; Gilliland et al 2001; Mannino et al 2001; Rizzi et al 2004).

Active tobacco smoking in adolescents is increasing in an alarming trend that appears independent from socioeconomic development or cultural background (Warren et al 2000; WHO 2003; CDC 2004; Mayo 2005). Few studies have looked at the effect

Correspondence: Javier Mallol
 Hospital CRS El Pino, Av. Los Morros
 13560, Santiago, Chile
 Tel +56 2 3874 694
 Fax +56 2 3874 662
 Email jmallol@usach.cl

of active tobacco smoking on the prevalence of asthma symptoms in adolescents and all of them have shown a significant increase of asthma-related symptoms in those who are active tobacco smokers (Leung et al 1997; Agudo Trigueros et al 2000; Yarnell et al 2003; Annesi-Maesano et al 2004; Sturm et al 2004). It has been reported that one-fifth or more of young people begin smoking cigarettes before the age of 10 years (Warren et al 2000).

The main instruments to assess asthma prevalence in children have been written and video questionnaires (ISAAC 1998; Mallol et al 2000). It is likely that for some populations of children who are not used to written questionnaires, or may have difficulties in understanding the exact meaning of the questions, the video questionnaire (VQ) may be a useful alternative instrument to get epidemiological information on asthma in childhood (Lai et al 1997; Fuso et al 2000; Crane et al 2003). It has been demonstrated that the VQ is a valid and reliable method of determining asthma prevalence and would provide data relatively free from bias due to language, culture, literacy, or interviewing techniques (Shaw et al 1992).

This study was undertaken to determine the effect of active tobacco smoking on the prevalence of respiratory symptoms related to asthma using the ISAAC international VQ in adolescents.

Material and methods

A random sample of 4738 schoolchildren aged 12 to 16 years (mean 13.4 ± 1.05 years) from a target population of 9780 schoolchildren in that age range and studying at schools of the surveyed area (a low-income area in the southern metropolitan area of Santiago, Chile), participated in this study. They were asked to answer the questions related to asthma symptoms scenes described in the international ISAAC's VQ and after finishing children were asked to respond two simple questions on tobacco smoking. The survey was accomplished by personal especially trained, nurses, and medical students.

The response rate was close to 100%, as children were interviewed at their classroom, and those who were not present at that time were surveyed during the next few days; none of them refused to answer the questionnaires.

As an official ISAAC Center we employed the methodology recommended by ISAAC for its centers all over the world which has been extensively described and widely employed in childhood asthma surveys (ISAAC 1998; Mallol et al 2000; Crane et al 2003), and its VQ questionnaires have been correspondingly validated (Shaw et al 1992; Lai et al 1997; Fuso et al 2000; Gibson et al 2000).

The questionnaires were applied to children in their schools and classrooms with previous explanation on the procedure and guaranteeing the privacy of those answers regarding tobacco smoking. Children were asked to carefully observe the scenes of the VQ consisting of 5 scenes corresponding to respiratory symptoms related to asthma: an adolescent wheezing at rest, wheezing after exercise, awaking at night with wheezing, awaking at night with dry cough, and suffering from a severe asthma attack with respiratory difficulty at rest. Sequentially, after the children had seen each asthma scene, they were asked to answer the referring question in the questionnaire form.

Immediately after ending the VQ, the children were asked to answer two simple questions on tobacco smoking in order to determine who were active smokers, nonsmokers, and ex-smokers. The questions were: "have you ever smoked tobacco cigarettes at anytime in the past?" and "have you been smoking one or more cigarettes per day during this last year?" Prior to asking these questions, it was assured to the adolescents that their answers would be kept strictly confidential.

This study was undertaken with the approval of the Ethics Committee of Hospital CRS El Pino, the informed consent of the parents, and with the authorization of directors of participant schools.

Analysis of the data

To determine the effect of active tobacco smoking on the prevalence of symptoms related to asthma using the ISAAC's VQ we divide the population of children according with the active tobacco consumption in four mutually exclusive categories: persistent smokers (ever smoked and continued smoking in the last year), ex-smokers (ever smoking but not in the last year), new smokers (smoking only in the last year) and nonsmokers (never tobacco smoking). Chi-square test was used for categorical variables and Student t-test for continuous variables. All tests were calculated in a 2-tailed manner and significance was defined by alpha level of 0.05.

The STATA 7.0 statistical program (Stata Corp, College Station, TX) was used for data analysis.

The number of children whose asthma-related symptoms (wheezing in the last 12 months) were attributable to active tobacco smoking was derived from the formula for attributable cases (Sturm et al 2004). The number of attributable cases (A_c) was derived from the number of children who were active persistent smokers (N_e), based on the following formula: $A_c = N_e \times [(RR - 1)/RR]$, where RR is relative risk. Relative risks were calculated from estimated

odds ratios (OR) according to the formula: $RR = OR / [(1 - p) + (OR \times p)]$, where p is the outcome incidence in the unexposed referent group (ie, children with wheezing in the last 12 months who were nonsmokers).

Results

From 4738 adolescents (mean age 13.4 ± 1.1 years old) who participated in the study, 2195 (46.3%) were male. The proportions of subjects in the four groups were: persistent smokers (16.2%; $n = 768$), ex-smokers (33.9%; $n = 1841$), new smokers (0%); and nonsmokers (44.9%; $n = 2129$). There were significantly more females among the persistent smokers than in the ex-smokers and nonsmokers groups: 59.6% versus 52.5% versus 52.5%, respectively, $p < 0.001$.

The persistent smokers had a significantly higher prevalence of asthma-like symptoms ever and in the last 12 months (wheezing, wheezing with exercise, wheezing during night, severe wheezing, and dry nocturnal cough) than ex-smokers and nonsmokers (Table 1).

The number of attributable cases of asthma-related symptoms (wheezing in the last 12 months) due to active tobacco consumption (persistent smokers) was 223 cases. This represented more than 27% of asthma symptoms in our adolescents.

Discussion

This study demonstrates that active tobacco smoking in adolescent results in a significantly higher prevalence of respiratory symptoms related to asthma as compared with those who stopped smoking during the last year (ex-smokers) or never smoked tobacco. This finding reinforces the effect of environmental factors, and importantly tobacco smoke, on increasing asthma prevalence. For example, about 27% of asthma symptoms in our adolescents are attributable to active tobacco consumption (population attributable risk). That number is slightly higher than those reported recently by Sturm and colleagues (2004) who estimated that more than 23% of active asthma cases in North Carolina middle school children were attributable to environmental tobacco smoke and active consumption with a considerable increase of cost in healthcare.

Recently in France, Annesi-Maesano and colleagues (2004) used ISAAC written questionnaire in adolescents to show more risk for wheezing in the past year among active smokers not exposed to passive smoking and in active smokers exposed to passive smoking than nonsmokers (OR, 95% confidence interval [CI]: 1.7, 1.1–2.4 and 1.9, 1.6–2.2, respectively). In the present study, using ISAAC VQ, the persistent smoker adolescent had significantly more risk for

Table 1 Prevalence (%) and odds ratios (95% CI) of asthma-like symptoms by video questionnaire; reports according to tobacco consumption groups

	Persistent smokers % OR (95% CI)	Ex-smokers % OR (95% CI)	Nonsmokers % OR (95% CI)
Wheezing ever	33.9 1.4 (1.2–1.7)*	28.1 1.1 (0.9–1.3)	26.3 1
Wheezing in the last 12 m	22.7 1.5 (1.3–1.9)*	17.0 1.1 (0.9–1.3)	16 1
Wheezing with exercise, ever	36.7 1.4 (1.1–1.6)*	28.2 0.9 (0.8–1.1)	29.9 1
Wheezing with exercise in the last 12 m	28.9 1.5 (1.3–1.9)*	20.8 1.0 (0.9–1.3)	20.9 1
Wheezing during night, ever	11.1 1.4 (1.1–1.8)†	9.7 1.2 (0.9–1.5)	8.3 1
Wheezing during night in the last 12 m	6.7 1.2 (0.9–1.7)	5.6 1.0 (0.8–1.3)	5.6 1
Cough ever	46.2 1.9 (1.6–2.3)*	32.8 1.1 (0.9–1.3)	30.8 1
Cough, in last 12 m	34.2 1.9 (1.6–2.3)*	23.3 1.1 (0.9–1.3)	21.3 1
Severe asthma crisis, ever	12.0 1.3 (0.9–1.7)	10.3 1.1 (0.8–1.3)	9.6 1
Severe asthma crisis, in the last 12 m	7.6 1.5 (1.1–2.1)‡	6.5 1.3 (0.9–1.7)	5.2 1

Notes: * $p < 0.001$; † $p \leq 0.01$; ‡ $p < 0.05$; Persistent smokers ($n = 768$), ex-smokers ($n = 1841$), and nonsmokers ($n = 2129$).

Abbreviations: CI, confidence interval; OR, odds ratio.

wheezing in the past year than nonsmokers (OR, 95% CI: 1.5, 1.3–1.9, $p < 0.001$).

Another interesting result in the present study is that adolescents who quit smoking (ex-smokers) have a similar prevalence of asthma-related symptoms than the nonsmokers. Yarnell and colleagues (2003) used the ISAAC written questionnaire in adolescents in Ireland to demonstrate that only self-report of active smoking but not ex-smoking was a risk factor for severe wheezing episodes. Moreover, Sturm and colleagues (2004), using the ISAAC video and written questionnaires in middle school children in North Carolina, found that even low levels of exposure (as low as consuming one cigarette per day) and environmental tobacco smoke at home are independently associated with asthma symptoms. These findings suggest that strong and extensive programs or campaigns against tobacco smoking should be implemented for young children and adolescents as that could decrease the prevalence of asthma and other respiratory problems related to tobacco exposure and potentially prevent tobacco smoking in adulthood.

Although the prevalence of active tobacco smoking among adolescent in our study (16.2%) is higher than reported by other authors using ISAAC questionnaires (13% in North Carolina [Sturm et al 2004], 9.3% in France [Annesi-Maesano et al 2004], and 8.5% in Ireland [Yarnell et al 2003]), it is still in the middle range according to a recent study done in adolescents from different countries where tobacco use in the surveyed age group ranged from 10% to 33% (Warren et al 2000).

A limitation of the present study, which is inherent to the ISAAC phase I protocol, is the fact that other risk factors (like family antecedent of asthma or atopy, pets, second-hand smoking, and other environmental factors) were not included in the core questionnaire. However, the main objective of this study is to report the influences of tobacco consumption in adolescents from a low income population.

Similarly to Agudo-Trigueros and colleagues (2000), we found significantly more females actively smoking tobacco than males, but this finding has not been consistently reported by another author (Annesi-Maesano et al 2004). Our finding that more female adolescents are actively smoking tobacco is striking because of the future implications of tobacco smoking in women at fertile age, considering the well known relationship existing between tobacco consumption during pregnancy and asthma-related symptoms in childhood, independently of a family history of asthma, socioeconomic factors, and birth weight (Stein et al 1999). In addition, we may be witnessing the success of tobacco industry advertising

in making cigarettes fashionable, particularly for children living in unprivileged conditions.

In conclusion, our findings strongly suggest that active tobacco consumption increases the prevalence of asthma-related symptoms. More than 27% of asthma symptoms in our adolescents may be attributable to active tobacco consumption (population attributable risk). Therefore, questions on active tobacco smoking should be included in every epidemiological research on asthma related symptoms in children, especially in developing countries where the consumption of tobacco at those ages, as well as environmental tobacco smoke exposure, is markedly increasing. This study strongly suggests that massive and more effective campaigns against tobacco smoking should be implemented in developing countries, where active tobacco smoking is dramatically increasing in adolescents, particularly females.

References

- Agabiti N, Mallone S, Forastiere F, et al. 1999. The impact of parental smoking on asthma and wheezing. SIDRIA Collaborative Group. Studi Italiani sui Disturbi Respiratori nell'Infanzia e l'Ambiente. *Epidemiology*, 10:692–8.
- Agudo Trigueros A, Garrich Aumatell T, Heras Fortuny D, et al. 2000. Smoking habits, exposure to environmental tobacco smoke, and respiratory symptoms in schoolchildren aged 14–15 years in Terrassa (Barcelona). *Gac Sanit*, 14:23–30.
- Annesi-Maesano I, Oryszczyn MP, Raheison C, et al. 2004. Increased prevalence of asthma and allied diseases among active adolescent tobacco smokers after controlling for passive smoking exposure. A cause for concern? *Clin Exp Allergy*, 34:1017–23.
- [CDC] Centers for Disease Control and Prevention. 2005. Tobacco use, access, and exposure to tobacco in media among middle and high school students—United States, 2004. *MMWR Morb Mortal Wkly Rep*, 54:297–301.
- Chilmonczyk BA, Salmun LM, Megathlin KN, et al. 1993. Association between exposure to environmental tobacco smoke and exacerbations of asthma in children. *N Engl J Med*, 328:1665–9.
- Crane J, Mallol J, Beasley R, et al; International Study of Asthma and Allergies in Childhood Phase I study group. 2003. Agreement between written and video questions for comparing asthma symptoms in ISAAC. *Eur Respir J*, 21:455–61.
- DiFranza JR, Lew RA. 1996. Morbidity and mortality in children associated with the use of tobacco products by other people. *Pediatrics*, 97:560–8.
- Fuso L, de Rosa M, Corbo GM, et al. 2000. Repeatability of the ISAAC video questionnaire and its accuracy against a clinical diagnosis of asthma. *Respir Med*, 94:397–403.
- Gibson PG, Henry R, Shah S, et al. 2000. Validation of the ISAAC video questionnaire (AVQ3.0) in adolescents from a mixed ethnic background. *Clin Exp Allergy*, 30:1181–7.
- Gilliland FD, Li YF, Peters JM. 2001. Effects of maternal smoking during pregnancy and environmental tobacco smoke on asthma and wheezing in children. *Am J Respir Crit Care Med*, 163:429–36.
- ISAAC Steering Committee. 1998. World-wide variations in the prevalence of asthma symptoms: the International Study of Asthma and Allergies in Childhood (ISAAC). *Eur Respir J*, 12:315–35.
- Jartti T, Lehtinen P, Vuorinen T, et al. 2004. Respiratory picornaviruses and respiratory syncytial virus as causative agents of acute expiratory wheezing in children. *Emerg Infect Dis*, 10:1095–101.

- Just J, Ségala C, Sahraoui F, et al. 2002. Short-term health effects of particulate and photochemical air pollution in asthmatic children. *Eur Respir J*, 20:899–906.
- Koenig JQ, Mar TF, Allen RW, et al. 2005. Pulmonary effects of indoor and outdoor generated particles in children with asthma. *Environ Health Perspect*, 113:499–503.
- Lai CK, Chan JK, Chan A, et al. 1997. Comparison of the ISAAC video questionnaire (AVQ3.0) with the ISAAC written questionnaire for estimating asthma associated with bronchial hyperreactivity. *Clin Exp Allergy*, 27:540–5.
- Leung R, Wong G, Lau J, et al. 1997. Prevalence of asthma and allergy in Hong Kong schoolchildren: an ISAAC study. *Eur Respir J*, 10:354–60.
- Mallol J, Solé D, Asher MI, et al. 2000. The prevalence of asthma symptoms in children from Latin America. The ISAAC study. *Pediatr Pulmonol*, 30:439–44.
- Mannino DM, Moorman JE, Kingsley B, et al. 2001. Health effects related to environmental tobacco smoke exposure in children in the United States: data from the Third National Health and Nutrition Examination Survey. *Arch Pediatr Adolesc Med*, 155:36–41.
- McConnell R, Berhane K, Gilliland F, et al. 2002. Asthma in exercising children exposed to ozone: a cohort study. *Lancet*, 359:386–91.
- Ministerio del Interior de Chile. 2005. Consejo Nacional para el Control de Estupefacientes. CONACE, Estadísticas: Consumo de Cigarrillos. Chile, Mayo. [Department of the Interior of Chile. 2005. National Advice for the Narcotic Control, Cigarette CONACE, Statistics: Consumption. Chile] Accessed on December 12, 2006. URL: <http://www.conacedrogas.cl/>.
- Morgan WJ, Crain EF, Gruchalla RS, et al; Inner-City Asthma Study Group. 2004. Results of a home-based environmental intervention among urban children with asthma. *N Engl J Med*, 351:1068–80.
- Preutthipan A, Udomsubpayakul U, Chaisupamongkollarp T, et al. 2004. Effect of PM10 pollution in Bangkok on children with and without asthma. *Pediatr Pulmonol*, 37:187–92.
- Rizzi M, Sergi M, Andreoli A, et al. 2004. Environmental tobacco smoke may induce early lung damage in healthy male adolescents. *Chest*, 125:1387–93.
- Shaw RA, Crane J, Pearce N, et al. Comparison of a video questionnaire with the IUATLD written questionnaire for measuring asthma prevalence. *Clin Exp Allergy*, 22:561–8.
- Stein RT, Holberg CJ, Sherrill D, et al. 1999. Influence of parental smoking on respiratory symptoms during the first decade of life: the Tucson Children's Respiratory Study. *Am J Epidemiol*, 149:1030–7.
- Sturm JJ, Yeatts K, Loomis D. 2004. Effects of tobacco smoke exposure on asthma prevalence and medical care use in North Carolina middle school children. *Am J Public Health*, 94:308–13.
- Warren CW, Leanne Riley L, Asma S, et al. 2000. Tobacco use by youth: a surveillance report from the Global Youth Tobacco Survey project. *Bull World Health Organ*, 78:868–76.
- [WHO] World Health Organisation Regional Office for Europe. 2003. Tobacco control database [online]. Accessed on December 12, 2006. URL: <http://data.euro.who.int/tobacco/>.
- Yarnell JW, Stevenson MR, MacMahon J, et al. 2003. Smoking, atopy and certain furry pets are major determinants of respiratory symptoms in children: the International Study of Asthma and Allergies in Childhood Study (Ireland). *Clin Exp Allergy*, 33:96–100.
- Young S, Le Souef PN, Geelhoed GC, et al. 1991. The influence of a family history of asthma and parental smoking on airway responsiveness in early infancy. *N Engl J Med*, 324:1168–73.

