

BRIEF COMMUNICATION

Externalizing and internalizing behavioural problems related to asthma in school children

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asthma; behavioural problems; onset; severity; Strengths and Difficulties Questionnaire.

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Abstract

We investigated the relationships of behavioural problems as assessed using the standardized Strengths and Difficulties Questionnaire (SDQ) to asthma in view of improving asthma management. Six thousand eight hundred and eighty children (mean age 10.4 years, male: 49%) were recruited in the French 6 Cities Study. Children with abnormal or borderline emotional symptoms (internalizing problems) or conduct problems (externalizing problems) were more asthmatic than others ($P < 0.01$). Compared to being normal, abnormal emotional symptoms or conduct problems were found to be related to mild-to-moderate persistent asthma (logistic model adjusted odds ratio = 1.55 (95% CI = 1.26–1.90) and 1.42 (95% CI = 1.17–1.71), respectively) and to early-onset asthma (Cox's model Adjusted Hazard Risk = 1.60 (95% CI = 1.27–2.01) and 1.34 (95% CI = 1.05–1.70). Borderline conduct problems were found to be negatively related to parents' knowledge on how to prevent asthma attacks, compared to normal conduct problems [adjusted OR = 0.51 (95% CI = 0.31–0.85)]. Further data are needed to better understand the involvement of behavioural problems in childhood asthma according to phenotypes.

Asthma is a common chronic disease (1) caused by a variety of factors (2). Recently, asthma has also been associated with stress and other psychological factors (3–5), although whether these precede or follow asthma is still controversial (Table 1). Among them, few investigations have investigated whether the association is modulated by asthma phenotypes, which could be useful for improving asthma management (3, 4, 6–8). All these studies used small populations.

The aim of this study was to investigate, in a large population-based sample of children and using internationally referenced instruments, the relationships between behavioural problems and current asthma considering its severity and age of onset, management and treatment adherence.

Methods

Participants

Nine thousand six hundred and fifteen children recruited in relevant primary school classes (CM1 and CM2 in France) in schools randomly selected in the frame of the French 6 City study (6C Study) (9) participated.

Behavioural problems

Emotional symptoms (internalizing problems) and conduct problems (externalizing problems) were assessed through the French validated version of the SDQ (Strengths and Difficulties Questionnaire) questionnaire scales. In each scale, all five items were scored based on a three-point Likert scale: 0 for 'not true', 1 for 'somewhat true' or 2 for 'very true' and summed up into a total score ranging from 0 to 10. According to the normative banding method for parent-reported SDQ scores in France (10), children were classified into 'normal', 'borderline' or 'abnormal' using the following cut-off points: 0–3, 4 and 5–10, respectively, for emotional (internalizing) problems; and 0–2, 3, 4–10, respectively, for conduct (externalizing) problems.

Asthma outcomes

The International Study of Asthma and Allergies in Childhood (ISAAC) Questionnaire filled by parents was used to assess current asthma (defined by wheezing or whistling in the chest in the past year and having ever had asthma) and

Table 1 Comparison of our study with prospective studies having investigated relationships between behavioural problems and childhood asthma

Studies	Differences					
	Age of samples	Behaviours/ instruments	Outcomes	Adjusted odds ratios/hazard risk, and other results	Confounders	Comments
Sandberg et al. (3) Acute and chronic stress and asthma attack	Recruited age: 6–13, followed up for 18 months (<i>n</i> = 90)	Life events/ PACE	New asthma attacks	Asthma attacks in subsequent 2–4 weeks: 1.71 (1.04–2.82); Asthma attacks in subsequent 4–6 weeks: 2.17 (1.32–3.57).	Age, sex, social class, parental smoking, season and asthma history	Not differentiating internalizing and externalizing problems, and small study population
Stevenson et al. (6) Relation between behavioural and asthma	Recruited age: 1–2, followed up for 18 months (<i>n</i> = 265)	Behavioural problems/BSQ	Asthma onset at age of 35–53 months	1.15 (1.02–1.29)	Treatment, IgE level for house dust mite, IgE level for grass pollen	
Calam et al. (7) Behavioural Problems antecede wheeze	Recruited prenatally, reviewed at ages of 3 and 5 (<i>n</i> = 771)	Behavioural problems/ECBI	Development of wheezing (parent report)	3.5(1.2–9.9)	Gender, maternal smoking, socioeconomic status	
Martin et al. (8) Acute stress and chronic family stress and immune change	Recruited age: 9–18, followed up for 2 years (<i>n</i> = 147)	Acute and chronic stress/ UCLALSI-CV	Production of cytokine interleukin (IL-4, IL-5, IL-13, and IFN- γ) and asthma symptoms	Increased production of IL-4, IL-5, IFN- γ and increased asthma symptoms	Medication, asthma severity and socioeconomic status	
6 Cities Study	Recruited age: 8–13, cross- sectional study (<i>n</i> = 6 880)	Internalizing and externalizing disorders/SDQ	Asthma severity and morbidity	1.55 (1.26–1.90) for internalizing problems and 1.42 (1.17–1.71) for externalizing problems	Child age, Gender, family history of asthma, passive smoking, mother age at delivery, parental educational level, parental socioeconomic status, family background and the number of children	The study could differentiate internalizing and externalizing problems, and large study population

PACE, The Psychosocial Assessment of Childhood Experiences; BSQ, Behavior Screening Questionnaire; ECBI, The Eyberg Child Behavior Inventory; UCLALSI-CV, University of California Los Angeles Life Stress Interview-Child Version; SDQ, Strengths and Difficulties Questionnaire.

asthma management and treatment adherence. Asthma severity at the period of the survey was classified as intermittent, mild persistent, moderate persistent and severe persistent using the 2004 Global Initiative for Asthma (GINA) guidelines (11). Early-onset asthma was defined as an asthma having started in the first 4 years of life according to the ‘Carnet de Santé’, which is compulsory in France, filled by the physician.

Statistical analysis

Classical statistical analysis was used to describe the sample and investigating missing data. Logistic proportional odds model for ordinal responses (12) was used to obtain odds ratios (OR) between behavioural problems and asthma outcomes after adjustment for potential confounders. The Cox’s proportional hazard model was used to compute hazard ratio

of the relationship between behavioural problems and asthma onset.

Version 9.3 of sas system (SAS Institute Inc., Cary, NC, USA) was used for statistical analyses.

Ethics

This study was approved by the French national Ethics Board (C.C.P.R.B., approval number: 01/07, Marseille AP, France). Parents signed a formal consent after having been informed about the study.

Results

Characteristic of study population

The 6880 children (72%) included in the analyses from 401 classrooms of 108 schools were aged 10.4 years in mean and in majority women (51%). They did not differ in characteristics and asthma outcomes from children with missing data ($P > 0.05$).

Behavioural problems and asthma outcomes

Emotional symptoms were abnormal in 15% of the children and borderline in 10%, whereas conduct problems were abnormal in 14% and borderline in 14%.

Children with behavioural problems, either emotional symptoms or conduct problems, had higher asthma prevalence rates ($P < 0.05$), and the relationships persisted after adjustment for confounders (Fig. 1). Emotional symptoms and conduct problems were related to an early asthma onset (50%) [HR = 1.60 (95% CI = 1.27–2.01) and 1.34 (95% CI = 1.05–1.70), respectively]. Borderline conduct problems were found to be negatively related to parents' knowledge on how to prevent asthma attack, compared to normal conduct problems [adjusted OR = 0.51 (95% CI = 0.31–0.85)].

Discussion

In our large population-based sample of children, internalizing and externalizing behavioural problems were related to mild to persistent asthma.

The evidence indicating the association between asthma and behavioural problems is increasing (3–8). Recently, Kohlboeck et al. (5) reported the association between asthma and emotional symptoms overall in nonatopic children, which contrasts with our results with a stronger link in atopic children. Several hypotheses have been proposed to explain why behavioural problems are related to asthma. Child's behavioural difficulties may result in part from disturbed family functioning or family structure also related to child's asthma (13). This could also depend on maternal depression associated with child's behaviour and lower self-efficacy in ability to care for their children with asthma. Lastly, behaviour could be at the origin of increasing symptoms frequency and asthma severity through poor asthma management (14). However, our findings did not support this explanation, as asthma management and treatment

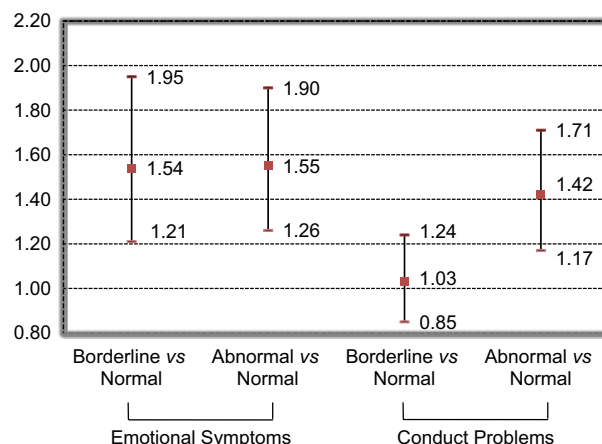


Figure 1 Relationships between asthma severity according to GINA and behavioural problems in the French 6 Cities study ($n = 6880$). Asthma prevalence: 16.7%, 16.0% and 11.1%, in abnormal, borderline and normal emotional symptoms respectively and 17.3%, 14.2% and 11.4%, in abnormal, borderline and normal conduct problems respectively. Squares are odds ratios (assessed by an adjusted logistic proportional odds model); bars are 95% Confidence Intervals. Confounders include: age, gender, family history of asthma and allergic diseases, passive smoking, mother age at delivery, parental educational level, parental socioeconomic status, family background (intact family, one parent family or other), and the number of children in the household. Asthma severity was classified as intermittent, mild persistent, moderate persistent (in our study, no child had severe persistent asthma), based on the combined assessments of asthma symptoms (frequency of diurnal and night attacks), peak expiratory flow and daily medication regimen for asthmatics already on treatment.

adherence were not associated with behavioural problems in our sample, except for parents' knowledge on how to prevent asthma attack relating to conduct problems. The potential physiological explanation for the relationships between behavioural problems and childhood asthma could be that children with externalizing and internalizing behavioural problems show high autonomic nervous system reactivity principally in the parasympathetic branch (15). Behavioural problems could also impact on the central nervous system to release hormones affecting the immune system, leading to increase Th2 (T helper-2 type) immune response to increase the risk of asthma (16). In our study, we found that both emotional (internalizing) and conduct (externalizing) problems were related to atopic asthma, which supports the hypothesis of an intervention of stress in allergic response. We also observed a link between behavioural problems and early-onset asthma that deserves to be further explained. To sum up, a complex picture of the behavioural difficulties associated with paediatric asthma has to be retained (17) to explain the link between behaviour and asthma in children.

Our results must be taken with caution because parents were the informant about both asthma and behavioural symptoms in our study. The cross-sectional study design

could also limit our results as it did not allow us exploring the possible causal relationships between behavioural problems and childhood asthma. Another limitation lies in the fact that we assessed asthma management and treatment adherence by a small set of screening questions with unknown psychometric properties, thus the results may not show the potential relationships between behavioural problems and asthma management and treatment adherence in our study population.

The strength of our study lies in the fact that we use data drawn from the general population and that a large sample is included in the study. In addition, we could differentiate internalizing and externalizing problems.

In conclusion, in our large sample drawn from the general population, emotional and conduct problems were positively associated with mild-to-moderate persistent asthma, thus suggesting the involvement of behavioural difficulties in childhood asthma. Whether behaviour adjustment has to be taken into account in the management of asthma needs further *ad hoc* investigations.

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Author contributions

Isabella Annesi-Maesano: Prof. Annesi-Maesano conceptualized and designed the study, drafted the initial manuscript,

and approved the final manuscript as submitted. Cailiang Zhou: Mr. Zhou engaged in the data set preparation, carried out the data analysis with Nour Baiz, Soutrik Banerjee and Prof. Annesi-Maesano, assisted in the drafting of the initial manuscript, and approved the final manuscript as submitted. Nour Baiz: Dr. Baiz engaged in the data set preparation, assisted in the data analysis, reviewed the manuscript and approved the final manuscript as submitted. Soutrik Banerjee: Dr. Banerjee assisted in the data analysis, reviewed the manuscript and approved the final manuscript as submitted. Denis André Charpin: Prof. Charpin participated in designing the data collection instruments, coordinated and supervised data collection in Marseille, reviewed the manuscript and approved the final manuscript as submitted. Denis Caillaud: Prof. Caillaud participated in designing the data collection instruments, coordinated and supervised data collection in Clermont-Ferrand, reviewed the manuscript and approved the final manuscript as submitted. Frédéric de Blay: Prof. de Blay reviewed the manuscript and approved the final manuscript as submitted. Chantal Raherison: Prof. Raherison participated in designing the data collection instruments, coordinated and supervised data collection in Bordeaux, reviewed the manuscript and approved the final manuscript as submitted. François Lavaud: Prof. Lavaud participated in designing the data collection instruments, coordinated and supervised data collection in Reims, reviewed the manuscript and approved the final manuscript as submitted.

Conflicts of interest

Dr. Annesi-Maesano, Mr. Zhou, Dr. Baiz, Dr. Banerjee, Dr. Charpin, Dr. Caillaud, Dr. Blay, Dr. Raherison and Dr. Lavaud have no competing interests to disclose.

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