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Original article

Management of asthma in French schoolchildren: The 6C study

La prise en charge de l'asthme chez les écoliers français : l'étude 6C

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Abstract

Objectives. – To describe the severity of asthma in schoolchildren in six cities in France in order to evaluate asthma management, observance and therapeutic education of both parents and children.

Participants and methods. – Nine thousand six hundred and forty one schoolchildren in 401 CM1 and CM2 classrooms in 108 randomly selected primary schools participated in a multicentre epidemiological cross-sectional survey in six French cities (the 6C study). A standardized questionnaire provided information on: (1) symptoms and severity of their asthma; (2) control and management of the asthma by parents and children.

Results. – Nine hundred and three children out of the 9641 participants were asthmatics. Of these asthmatic children, 22.3% had had no previous medical diagnosis of asthma. Among the asthmatic children, 77.3% suffered from intermittent asthma, 9.9% from mild persistent asthma and 12.8% from moderate persistent asthma. The asthmatic children were being followed mainly by pediatricians or general practitioners. Nearly a third (30%) of the parents knew how to prevent an asthma attack and more than half said that they knew how to use asthma medication in the event of severe attacks. Few parents knew the cause of the attacks. Peak flow-meters were rarely used. The positive effects of physical exercise were poorly known, especially by parents whose children suffered from mild asthma.

Conclusion. – Guidelines for asthma control and management in France can be improved. The parents of children with mild or un-diagnosed asthma should be targeted. Guidelines for treatment and care must be adapted to the culture, the socioeconomic context and to the family's level of knowledge (or ignorance) of the disease.

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Keywords: Asthma; Management; Severity; Children; Parents

Résumé

Objectifs. – Décrire la gravité de l'asthme chez les écoliers dans six villes françaises, afin d'évaluer la prise en charge de l'asthme, l'observance et l'éducation thérapeutique des parents et des enfants.

Population et méthodes. – Neuf mille six cent quarante et un écoliers de 401 salles de classe de CM1 et CM2 dans 108 écoles primaires choisies au hasard dans le cadre de l'étude des six villes. Un questionnaire standardisé a permis d'obtenir des informations sur : (1) symptômes et gravité d'asthme ; (2) contrôle et prise en charge de l'asthme par les parents et les enfants.

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Résultats. – Neuf cent trois enfants sur les 9641 ayant participé à l'enquête étaient asthmatiques. De ces enfants asthmatiques, 22,3 % n'avaient eu aucun diagnostic médical antérieur d'asthme. Parmi les enfants asthmatiques, 77,3 % des enfants souffraient d'asthme intermittent, 9,9 % d'asthme persistant léger et 12,8 % d'asthme persistant modéré. Les asthmatiques étaient suivis principalement par des pédiatres ou généralistes. Presque un tiers (30 %) des parents savaient comment prévenir les crises d'asthme et plus de la moitié déclarait connaître les médicaments contre l'asthme en cas de crises graves. Peu de parents connaissaient les causes des crises. L'utilisation d'un débitmètre de pointe était rare. Les effets positifs de l'exercice physique étaient mal connus, en particulier par les parents dont les enfants souffraient d'asthme léger.

Conclusion. – Les lignes directrices sur la prise en charge de l'asthme peuvent être améliorées en France. Elles doivent cibler aussi les parents d'enfants ayant eu un diagnostic d'asthme léger ou n'ayant pas été encore diagnostiqué. Les lignes directrices sur les traitements et les soins doivent être adaptés à la culture, le contexte socioéconomique et le niveau de connaissance (ou l'ignorance) de la maladie par la famille.

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Mots clés : Asthme ; Prise en charge ; Sévérité ; Enfants ; Parents

1. Introduction

Asthma is the most frequent chronic disease in children and its prevalence continues to increase [1–4]. In France, asthma is responsible each year of 600 000 days of hospitalization (short stay), approximately 1000 deaths and generates more than one billion euros of health expenditure [5]. Children are at greater risk for both asthma hospitalisation and death than the rest of the population. According to the *Programme de médicalisation des systèmes d'information* (PMSI) dataset, the annual standardised hospitalisation rate for asthma is 9/10 000. In addition, the *Organisation de la Surveillance COordonnée des URgences* (OSCOUR) network indicates that in the Parisian Region there are up to 40 ER department visits per month for asthma. Previous studies have shown that asthma education and case management may reduce asthma emergency care, hospitalizations, and expenditures [6]. The International Study of Asthma and Allergies in Childhood (ISAAC), using a standardized methodology, constitutes one of the most important investigations carried into asthma and the allergies in infantile general population [7]. The six Cities Study (6C), the French contribution to ISAAC, was carried out in a representative population-based sample of schoolchildren in six cities in France (metropolitan area) in order to estimate the prevalence and severity of asthma and to study its risk factors, air pollution in particular, in contrasted zones [8]. The objectives of the present study are to describe the severity of childhood asthma and to evaluate asthma management, observance and therapeutic education using the data of both parents and children in the 6C Study with an enriched ISAAC protocol.

2. Methods, design, setting and participants

A cross-sectional survey was conducted in 401 randomly selected classrooms of 108 randomly selected primary schools in six cities (Strasbourg, Reims, Créteil, Bordeaux, Clermont-Ferrand, Marseilles). Nine thousand six hundred and forty one participants aged 10 to 13 years issued from the general population of schoolchildren of French primary school (levels 9 and 10, CM1 and CM2 in France) were involved in the study. Parents were asked to complete an enriched version of the standardized ISAAC questionnaire, and children were sub-

mitted to a medical examination for allergic and respiratory diseases by a qualified medical practitioner. Asthma severity was assessed according to the Global Initiative for Asthma (GINA) classification in intermittent, mild persistent, moderate persistent and severe persistent (<http://www.ginasthma.com/>).

3. Results

3.1. General characteristics of the population

The analyses were performed in the panel of asthmatics as defined on the basis of the presence of asthmatic symptoms children ($n = 903$) (Table 1). Among them (11.6% of the observed population) aged 10.4 years (8–13.2 years) in mean, the prevalence of past year asthma (wheezing and whistling in the chest in the last 12 months) was 7.98% ($n = 72$). Among the children, 77.3% suffered from intermittent asthma, 9.9% from mild persistent asthma and 12.8% from moderate persistent. None had severe persistent asthma. One hundred and forty-three boys and 90 girls had repeated a class; most of them were in the group of mild persistent asthma (Table 2).

Table 1
Geographical variations of asthma according to Global Initiative for Asthma (GINA)^a classification by town.

Centers	Schoolchildren Schools	GINA 1 (%)	GINA 2 (%)	GINA 3 (%)	GINA 4 (%)
Créteil	175 20	130 (74.3)	17 (9.7)	28 (16)	0
Reims	116 20	86 (74.1)	17 (14.7)	13 (11.2)	0
Marseille	164 17	132 (80.5)	13 (7.9)	19 (11.6)	0
Strasbourg	142 14	114 (80)	13 (7.9)	15 (10.6)	0
Clermont	137 18	110 (80.3)	8 (5.8)	19 (13.9)	0
Bordeaux	169 16	126 (74.6)	21 (12.4)	22 (13)	0
Total		698	89	116	0

^a GINA classification: intermittent (GINA 1), mild persistent (GINA 2), moderate persistent (GINA 3) and severe persistent (GINA 4) (<http://www.ginasthma.com/>).

Table 2

Frequency of asthma according to Global Initiative for Asthma (GINA)^a classification and gender.

GINA classification	Boys (1) (%)	Girls (2) (%)	Total (%)
GINA1	422 (46.7)	276 (30.6)	698 (77.3)
GINA2	55 (6.1)	34 (3.8)	89 (9.9)
GINA3	68 (7.5)	48 (5.3)	116 (12.8)

^a GINA classification: intermittent (GINA 1), mild persistent (GINA 2), moderate persistent (GINA 3) and severe persistent (GINA 4) (<http://www.ginasthma.com/>).

In the couples of parents of the same origin (665/784 = 84.8%), the majorities were native of France (metropolitan area) (58%) (524/665 = 78.8%); the second most represented community being then that of the Maghreb (57/665 = 8.57%). As regards to level of study, the majority of the parents (88%), taken individually (617/701 = 88.0%) or in couple (429/476 = 90.1%), reached at least the secondary education level (high school diploma). Near half of these (43%) had began higher education (first-year university level and beyond) respectively (302/701 = 43.1%) and (211/476 = 44.3%). Only 7.6% of the parents were at the first level and 2.3% declared another diploma.

3.2. Diagnosis, first attack and severity of asthma

Nearly a quarter of the asthmatic children (22.3%) had had no medical diagnosis of asthma during their life, while 694 children (77.7%) saw their asthma previously diagnosed by a doctor. The first attacks of whistling, wheezing or asthma took place at an average age of 4.4 years. During the month preceding the study, 6.3% of the children had more than one attack a week. Children with moderate persistent asthma had five attacks or more a week, with an average maximum of two attacks a day (Table 3). The duration of the crisis was more than one hour for 13.2% and up to several days for 13.2% of the children (Table 3).

3.3. Seasonality of the asthma, night-asthma and periodicity

The asthmatic children had attacks all year round. The observation over the last year shows two peaks in October

($n = 146$) and December ($n = 145$) in the wintry season and a minimum in February ($n = 78$), with an average of 121 attacks a month. One child out of four had night-asthma attacks; 35% of those with intermittent asthma had waked up at least two nights a month, 33% of those with mild persistent asthma more than two nights a month and 29% of those with moderate persistent asthma several nights a week.

3.4. Asthma care and management

The average number of consultations was three per year. Near half of the consultations were assured by the general practitioner or the paediatrician. The others were provided by respiratory doctors, allergologists and at dispensary, hospital. . . The parents declared 81 days of hospitalization for asthma in the year preceding the inquiry; with a maximum of 32 days for a small asthmatic child with severity grade 3 in Clermont-Ferrand. Forty-five percent of the children who had to face attacks of wheezing, whistles or asthma in the 12 months preceding the study took drugs. Short-term β -stimulants were the most used drugs (64.2% of the cases), followed by corticoids in inhalation (36.1% of the cases). Only 3% of the children used a peak flow-meter at home to measure their expiratory flow. Most asthmatics found it tedious and give up this practice quickly.

3.5. School asthma absenteeism and sport

The majority of the asthmatic children (63.1%) was not touched by the school absenteeism; most children were normal or even in advance at school taking the age as a criterion (Table 4). The majority of the asthmatic children were exempted of sport (56%) by their parents because of wheezing, whistling or asthma. All the children with intermittent asthma were exempted. On the 12 asthmatic children who regularly practised sport at school, seven had mild persistent asthma and five moderate persistent.

3.6. Therapeutic education and observance

Fifty-seven percent of the parents declared they had a good knowledge of the disease of their child and of the treatment as well as of the therapeutic observance. Three hundred and

Table 3

Distribution of asthma or wheezing attacks.

	Total (%)
Frequency of attacks	
0 = no more attacks	157 (30.3)
1 = less of 1 attack/year	110 (21.2)
2 = less of 1 attack/month	131 (25.2)
3 = one or more attacks/month	88 (17.0)
4 = one or more attacks/week	22 (4.2)
5 = one or more attacks/day	11 (2.1)
Length of attacks	
1 = some minutes	223 (24.6)
2 = one or several hours	119 (13.2)
3 = some days	120 (13.2)

Table 4

Advance and delay at school in asthmatic children according to asthma severity as indicated by Global Initiative for Asthma (GINA)^a classification.

Classification	Schoolchildren			
	In advance (%)	Normal (%)	In retard (%)	Total (%)
GINA1	184 (26.36)	328 (46.99)	186 (26.65)	698 (100)
GINA2	20 (22.47)	42 (47.19)	27 (30.34)	89 (100)
GINA3	34 (29.31)	62 (53.45)	20 (17.24)	116 (100)
Total	238	432	233	903

^a GINA classification: intermittent (GINA 1), mild persistent (GINA 2), moderate persistent (GINA 3) and severe persistent (GINA 4) (<http://www.ginasthma.com/>).

fourteen parents (34.8%) said to have learned how to make prevention of the attacks; 491 parents (54.4%) said to know medications to give to the child in the event of attacks; these answers agree with the declarations on the use of the drugs. Asian parents seemed the least well prepared, two only of the 24 couples of Asian origin said to know how to prevent asthma attacks. The therapeutic observance was good for 67.9% of the French parents from DOM-TOM (French Overseas Departments); 60% of the parents of Southern Europe; 55% of the parents of Sub-Saharan Africa, 41.1% of the metropolitan French parents, 38.6% of the parents of North Africa, 16.6% of the Asian parents and 63.6% of the parents of another origin. All in all, the therapeutic observance was good in 42% of the cases; only some parents of children with intermittent asthma did not give their child the treatment although this one was prescribed by the doctor. The bases of therapeutic education seemed acquired for the majority of the asthmatic children; 321 parents (35.5%) declared that their children had learn how to deal with their asthma, and according to their parents 59.2% of the children were able to self-manage their disease.

4. Discussion

The 903 asthmatic children accounted for 11.6% of the schoolchildren investigated in the 6C Study. Among them, the prevalence of past year asthma was 7.98%. In most children (77.3%), asthma was not severe (severity grade 1 according to GINA). No child presented severe persistent asthma (GINA severity grade 4) in our population-based sample; 9.9% and 12.2% presented asthma of severity grade 2 and 3 respectively. Surprisingly, nearly a quarter (22.3%) of the asthmatic children included in the study had not had a medical diagnosis of asthma during their life. The characteristics of asthmatics without a medical diagnosis were discussed largely elsewhere [9]. These results confirm that in France, like elsewhere, childhood asthma remains a frequent and partly under-diagnosed pathology affecting individuals whatever their geographical origin, ethnic or social [10,11]. The observation of the temporal variations over the last year shows as in Europe and elsewhere two peaks for asthma exacerbations in autumn and wintry season [12,13], which confirms the quality of the collected data. The average age for the first attack of wheezing or asthma (4.4 years) agrees with the data, which show that 50% of asthma cases begin in early childhood (before the age of 5 years) [14].

Although several studies showed that the treatment and the follow-up by a lung specialist contributed to a better control of the illness, the majority of the asthmatic children was followed by pediatricians or general practitioners in our population [15–17]. The cost and accessibility to the specialist are certainly to blame in this respect. Although a third of the questioned parents says to have learned how to make prevention of the attacks and that more than half says to know good medication to be given to the child in the event of attacks, little is known about the origin of the attacks and the influence of the causes on the frequency of these attacks or the control (or the absence) that the parents have some. It was also noted that the use of the peak flow-meter is rare (3%) in the studied population, whereas it is an

invaluable tool in the chronic follow-up of asthma, but the good integration of the instructions of the doctor is imperative for a correct use [18,19]. However, recent data have not concluded to the effectiveness of peak expiratory flow in asthma. Few children use the sport like an accompaniment of their disease; the parents whose children suffer from weak asthma exempt their children of sport whereas it is proven that subject to some care that the physical exercise contributes to a better control of the asthmatic disease and can contribute to mitigate certain effects [20]. These precautions can be effective only in the case of self-management of the disease by the child and suitable information to the parents, but also to the teachers in charge with this type of activity [21,22]. Information and training must make it possible to better understand and manage asthma with the daily activity and of knowing how to deal with the more difficult situations. The goal is to lead the young patient, who is not any more a kid, to act as an active partner in the treatment of its asthma [23].

A major limitation of our study was the lack of data allowing to fully assess asthma control in children such as the number of daily attacks per week, activity limitations due to asthma and rescue medication at least twice per week. Indeed, at the period of the survey asthma severity was considered the most important criterion to be considered in the asthma management. In addition, the GINA classification that was used in our study has been considered as poorly appropriate for the children. In particular, intermittent asthma in children could be overestimated by GINA.

5. Conclusions

In our population-based sample, a quarter of the asthmatic children never had a medical diagnosis of asthma, gap underlined in several other studies [17], this in spite of the fact that the importance of an early diagnosis for a positive evolution and the control of the asthmatic disease have already been underlined [24]. Although several indicators confirm the efficiency of the guidelines for asthma control and management to the children and their parents, existing directives seem perfectible, in particular for reaching, sensitizing and educating the parents of the children that are non-diagnosed or with weak asthma. Indeed, our results, as underlined by others [25–27], confirm the contradictory impact of certain directives and the need for adapting teaching of the knowledge, treatments, care and techniques, to the culture, the socioeconomic context and level of knowledge (or ignorance) of the disease of the family.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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References

- [1] Braman SS. The global burden of asthma. *Chest* 2006;130(1 Suppl.): 4S–12S.
- [2] Annesi-Maesano I. Épidémiologie de l'asthme de l'enfant. *Med Ther Pediatr* 1999;2(3):162–8.
- [3] Bousquet DG. Une synthèse sur l'épidémiologie de l'asthme. *Rev Fr Allergol Immunol Clin* 2005;45(6):464–75.
- [4] Hublet A, Andersen A, Godeau E, Vereecken C, Valimaa R, Tynjala J, et al. Asthma and wheezing symptoms in young people in six Western countries. *Rev Epidemiol Sante Publique* 2006;54(4):305–12.
- [5] Annesi-Maesano I. Épidémiologie de l'asthme dans le monde et en France. *Rev Prat* 2011;61:329–35.
- [6] Bhaumik U, Norris K, Charron G, Walker SP, Sommer SJ, Chan E, et al. A cost analysis for a community-based case management intervention program for pediatric asthma. *J Asthma* 2013;50(3):310–7.
- [7] Anonyme. Worldwide variation in prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and atopic eczema: ISAAC. The International Study of Asthma and Allergies in Childhood (ISAAC) Steering Committee. *Lancet* 1998;351(9111):1225–32.
- [8] Annesi-Maesano I. Étude de l'impact de la pollution de l'air à l'intérieur et à l'extérieur des locaux sur la santé respiratoire et allergique de l'enfant dans des zones contrastées de la France. L'étude des six villes, Final report of the French contribution to the International Study of Asthma and Allergies in Childhood Phase II (ISAAC II). In: U472 RsfP-PI, editor; 2002.
- [9] Annesi-Maesano I, Sterlin C, Caillaud D, de Blay F, Lavaud F, Charpin D, et al. Factors related to under-diagnosis and under-treatment of childhood asthma in metropolitan France. *Multidiscip Respir Med* 2012;7(1):24 [doi:10.1186/2049-6958-7-24].
- [10] Petronella SA, Conboy-Ellis K. Asthma epidemiology: risk factors, case finding, and the role of asthma coalitions. *Nurs Clin North Am* 2003; 38(4):725–35.
- [11] Wickman M, Lilja G. Today, one child in four has an ongoing allergic disease in Europe. What will the situation be tomorrow? *Allergy* 2003; 58(7):570–1.
- [12] Hashimoto M, Fukuda T, Shimizu T, Watanabe S, Watanuki S, Eto Y, et al. Influence of climate factors on emergency visits for childhood asthma attack. *Pediatr Int* 2004;46(1):48–52.
- [13] Kao CC, Huang JL, Ou LS, See LC. The prevalence, severity and seasonal variations of asthma, rhinitis and eczema in Taiwanese schoolchildren. *Pediatr Allergy Immunol* 2005;16(5):408–15.
- [14] Delacourt C. Diagnostic de l'asthme chez l'enfant. *Med Ther Pediatr* 1999;2(3):174–9.
- [15] Backer V, Nepper-Christensen S, Nolte H. Quality of care in patients with asthma and rhinitis treated by respiratory specialists and primary care physicians: a 3-year randomized and prospective follow-up study. *Ann Allergy Asthma Immunol* 2006;97(4):490–6.
- [16] Moeller A, Steurer-Stey C, Suter H, Hofer M, Peter M, Brooks-Wildhaber J, et al. Disease control in asthmatic children seen in private practice in Switzerland. *Curr Med Res Opin* 2006;22(7):1295–306.
- [17] Nolte H, Nepper-Christensen S, Backer V. Unawareness and under-treatment of asthma and allergic rhinitis in a general population. *Respir Med* 2006;100(2):354–62.
- [18] Lopez-Vina A, del Castillo-Arevalo E. Influence of peak expiratory flow monitoring on an asthma self-management education programme. *Respir Med* 2000;94(8):760–6.
- [19] Bheekie A, Syce JA, Weinberg EG. Peak expiratory flow rate and symptom self-monitoring of asthma initiated from community pharmacies. *J Clin Pharm Ther* 2001;26(4):287–96.
- [20] Rasmussen F, Lambrechtsen J, Siersted HC, Hansen HS, Hansen NC. Low physical fitness in childhood is associated with the development of asthma in young adulthood: the Odense schoolchild study. *Eur Respir J* 2000; 16(5):866–70.
- [21] Merbai S. L'accueil de l'enfant asthmatique à l'école. *Med Ther Pediatr* 2004;7(5):315–23.
- [22] Sestini P, Ciarleglio G, Forastiere F, Giannella G, Battisti L, Gentilini M, et al. [Asthma attacks at school in Italian adolescents]. *Epidemiol Prev* 2005;29(2 Suppl.):77–9.
- [23] de Blic J. Prise en charge thérapeutique de l'asthme de l'enfant : du consensus à la pratique. *Rev Fr Allergol Immunol Clin* 2005;45(4):308–13.
- [24] Schonberger H, van Schayck O, Muris J, Bor H, van den Hoogen H, Knottnerus A, et al. Towards improving the accuracy of diagnosing asthma in early childhood. *Eur J Gen Pract* 2004;10(4):138–45. 151.
- [25] Duran-Tauleria E, Rona RJ, Chinn S, Burney P. Influence of ethnic group on asthma treatment in children in 1990-1: national cross-sectional study. *BMJ* 1996;313(7050):148–52.
- [26] Saxena S, Eliahoo J, Majeed A. Socioeconomic and ethnic group differences in self reported health status and use of health services by children and young people in England: cross-sectional study. *BMJ* 2002;325(7363):520.
- [27] Sproston KA, Pitson LB, Walker E. The use of primary care services by the Chinese population living in England: examining inequalities. *Ethn Health* 2001;6(3-4):189–96.