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Agricultural exposure and asthma risk in the AGRICAN French cohort

Isabelle Baldi[a,b,c,*], Céline Robert[a,b], Florence Piantoni[a,b], Séverine Tual[d,e,f], Ghislaine Bouvier[a,b], Pierre Lebailly[d,e,f], Chantal Raherison[a,b,g]

[a] Université Bordeaux, ISPED, Laboratoire Santé Travail Environnement, F-33000 Bordeaux, France
[b] INSERM, ISPED, Centre INSERM U897-Epidemiologie-Biostatistique, F-33000 Bordeaux, France
[c] CHU de Bordeaux, Service de Médecine du Travail, F-33000 Bordeaux, France
[d] INSERM, UMR1086-Cancers et Préventions, F-14000 Caen, France
[e] Univ. Caen Basse-Normandie, F-14000 Caen, France
[f] Centre François Baclesse, F-14000 Caen, France
[g] CHU de Bordeaux, Service de Pneumologie, F-33400 Pessac, France

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ABSTRACT

Epidemiological studies have reported an increased risk of respiratory diseases in agricultural population, but a protective "farm-effect" has also been reported for asthma. In the AGRICAN cohort, self-reported doctor-diagnosed asthma was analyzed according to allergy, in relation with history of life-time exposure to 13 crops and 5 livestock, pesticide exposure and early life on a farm, taking into account sex, age, education and body mass index. Among the 1246 asthmatics (8.0%), 505 were allergic (3.3%) and 719 non-allergic (4.6%). In multivariate analysis, a significant excess was observed, only for allergic asthma, in vine-growing (OR = 1.43, $p = 0.002$), fruit-growing (OR = 1.58, $p = 0.001$), greenhouses (OR = 1.66, $p = 0.02$), grasslands (OR = 1.35, $p = 0.009$), beets (OR = 1.52, $p = 0.003$) and horses (OR = 1.35, $p = 0.04$). Pesticide use and history of pesticide poisoning were significantly associated with allergic asthma in grassland, vineyards and fruit-growing and with non-allergic asthma in beets. Living on a farm in the first year of life tended to be protective for childhood allergic asthma in farms with livestock (OR = 0.72, $p = 0.07$) but deleterious in farms with vineyards, fruit or vegetables (OR = 1.44, $p = 0.07$). In AGRICAN, an increased risk of allergic asthma was observed with crop exposure, pesticide use and early life on a farm, especially in vine-growing, grassland, beets, fruit and vegetable-growing.

Introduction

Two major epidemiological studies, one among children ("Worldwide variation in prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and atopic eczema," 1998) and another among young adults (Burney et al., 1994), have estimated the prevalence of asthma worldwide and demonstrated that it is one of the most common chronic conditions. They suggest that 200–300 million people suffer from asthma worldwide (Masoli et al., 2004). In France, the prevalence of asthma is estimated to be 6.7% in adults and 9.8% in children (Raherison et al., 2007). Moreover, a substantial increase in this prevalence has been observed in most countries in recent decades, suggesting that environmental changes could play a large role, probably in association with genetic predisposition. Epidemiological data consistently indicate a high contribution of occupational exposure, which could explain 18% of the total burden of asthma in the populations according to a systematic analysis of population-attributable fractions (Torén and Blanc, 2009). A wide range of occupations have been associated with asthma such as painting, hairdressing, cleaning, health care professions and baking (Mapp et al., 2005). The farm environment corresponds to a mixture of various forms of exposure such as dust, mold, animals, crops, pesticides and other chemicals, which have been recognized to promote the occurrence of lung diseases ("Respiratory health hazards in agriculture," 1998). Nevertheless, the impact of farming on asthma appears controversial. Some studies have shown that being raised on a farm is protective, specifically against atopic asthma (Braun-Fahrländer et al., 1999; Douwes et al., 2007; Leynaert et al., 2001; von Mutius, 2007). Other studies indicated that farming was related to an increase in asthma risk in adults (Kogevinas et al., 1999; Monsó et al., 2000; "Respiratory health hazards in agriculture," 1998). A French study found that respiratory conditions were more frequent in dairy farmers compared to unexposed controls living in rural areas (Dalphin et al., 1998). Comparable results for asthma were found in farmers involved in livestock, and especially cattle and hogs (Choudat et al., 1994). A large agricultural prospective cohort, the Agricultural Health Study (AHS), demonstrated that farm animals breeders (Hoppin et al.,

* Corresponding author at: Equipe Santé Travail Environnement, Centre INSERM U897, Université Bordeaux Segalen, 146 rue Léo Saignat, 33076 Bordeaux, France. Tel.: +33 557 571 234; fax: +33 557 571 698.
E-mail address: Isabelle.Baldi@isped.u-bordeaux2.fr (I. Baldi).

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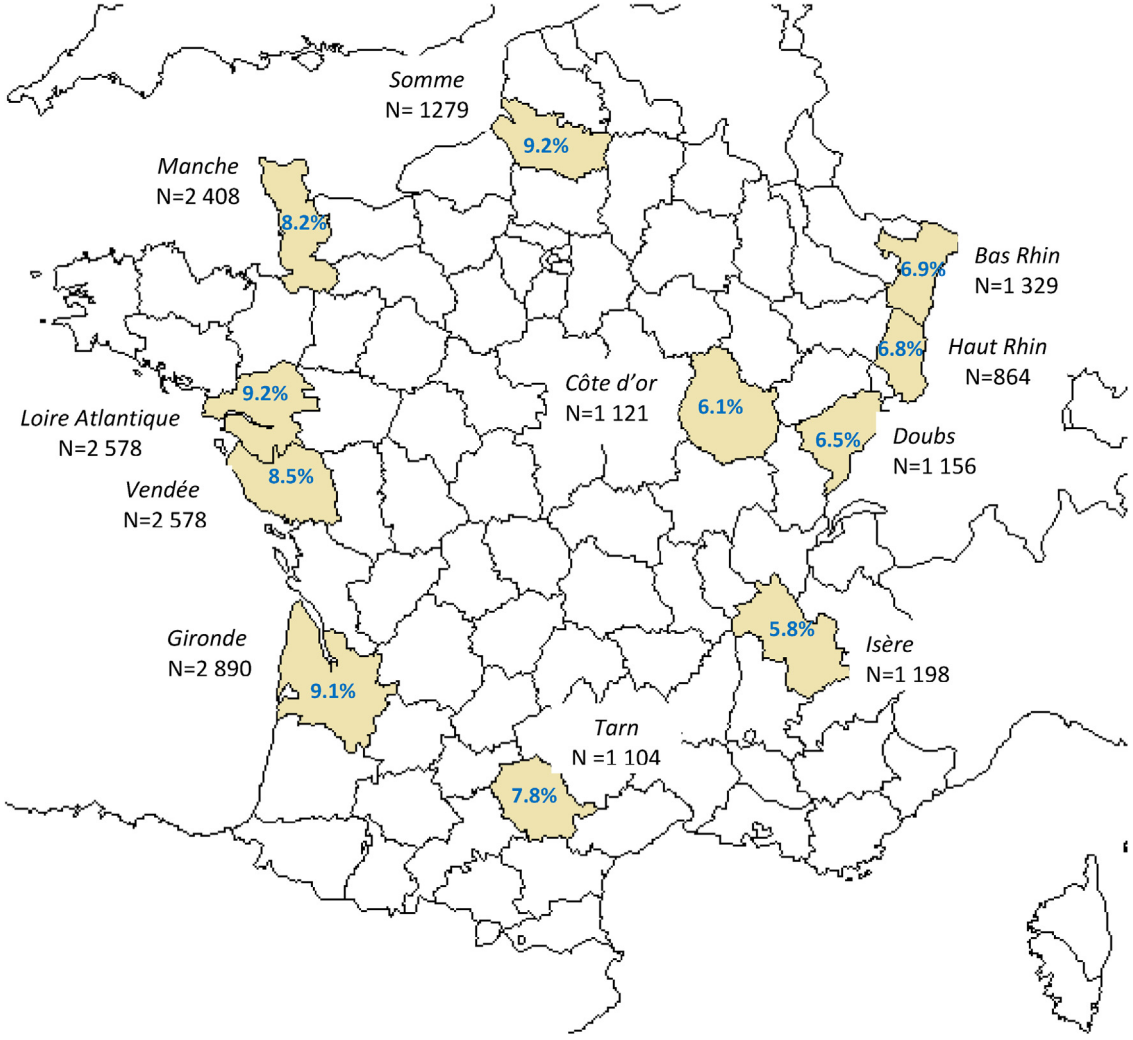

Fig. 1. Number of subjects and prevalence of asthma in the 11 departments of the AGRICAN study (enrolment, 2005–2007).

2003), commercial pesticide applicators and farmers (Hoppin et al., 2006) had a higher risk of wheezing. In the AHS, pesticide use was associated with adult onset asthma in male farmers (Hoppin et al., 2009) and specifically with atopic asthma in farm women (Hoppin et al., 2008). The differences between the studies could be due to differences in the timing (early life or during adulthood) or/and type of farming. The French agricultural setting offers a good opportunity to study the respiratory effects of agricultural exposures as it comprises a wide range of crops and livestock, with a large number of farmers and farm workers (about 5 million professionally active or retired in 2012), and with the greatest use of pesticides in Europe.

We analyzed the role of agricultural exposure, including pesticide use and early life on a farm, on the presence of asthma with and without allergy, at enrolment in a large agricultural prospective cohort: the AGRICAN study.

Methods

Population

The main objective of the AGRICAN cohort was to study the link between agriculture and cancer incidence and mortality in a large French agricultural population. Secondary aims included the study of respiratory conditions and neurological disorders. The eligible population consisted of all adults, men and women, active or retired, farm-owners and workers, affiliated to the Mutualité Sociale Agricole (MSA), the French Health insurance scheme in agriculture. To be included, individuals had to be 18 years old or over, to have paid at least 12 quarterly contributions to the MSA, and in 2004 to be living in one of the eleven French areas where cancer registries (certified by the National Registry Committee) were set up (Fig. 1). Enrollment was by mail from November 2005 to June 2007. In 2008, 180,060 self-administered questionnaires had been completed and returned (31.7% of eligible individuals). A 10% random sample of these questionnaires was available for preliminary analysis and was used in the current investigation.

Questionnaire

The self-administered questionnaire included: (i) socio-demographic variables (age, sex, education, and marital status), (ii) health outcomes at enrollment (15 diseases including asthma, hay fever and eczema), (iii) occupational data: complete occupational history, history of crops and livestock (the question was: "Have you ever grown this crop/livestock? Yes/No"), details on 2–5 agricultural tasks for each crop/livestock (with years of beginning and end of each task including pesticide use), and history of pesticide poisoning, (iv) other conditions likely to impact health: reproductive life, diet, smoking and alcohol consumption. Moreover, participants