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Pesticide exposure of non-occupationally exposed subjects compared to some occupational exposure: A French pilot study

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Abstract

Data about non-dietary exposure to different chemical classes of pesticides are scarce, especially in France. Our objective was to assess residential pesticide exposure of non-occupationally exposed adults, and to compare it with occupational exposure of subjects working indoors. Twenty unexposed persons, five gardeners, seven florists and nine veterinary workers living in Paris area were recruited. Nineteen residences, two greenhouses, three florist shops and three veterinary departments were then sampled. Thirty-eight insecticides, herbicides and fungicides were measured in indoor air with an air sampler for 24 h, and on hands by wiping them with isopropanol-wetted swabs. After extraction, samples were analysed by gas and high-performance liquid chromatography. Seventeen different pesticides were detected at least once in indoor air and twenty-one on the hands. An average of 4.2 ± 1.7 different pesticides was detected per indoor air sample. The organochlorines lindane, α-endosulfan and α-HCH were the most frequently detected compounds, in 97%, 69% and 38% of the samples, respectively. The organophosphates dichlorvos and fenthion, the carbamate propoxur and the herbicides atrazine and alachlor were detected in more than 20% of the air samples. Indoor air concentrations were often low, but could reach 200–300 ng/m^3 in residences for atrazine and propoxur. Propoxur levels significantly differed between the air of veterinary places and other places (Kruskal–Wallis test, $p < 0.05$) and dieldrin levels between residences and workplaces ($p < 0.05$). There was a greater number of pesticides on hands than in air, with an average of 6.3 ± 3.3 different pesticides detected per sample, the most frequently detected being malathion, lindane and trifluralin, in more than 60% of the subjects. Maximal levels (up to 1000–3000 ng/hands) were observed either in the general population or in workers, depending on the pesticide. However, no significant difference was observed between workers and general population handwipe pesticide levels. As expected, gardeners were exposed to pesticides sprayed in greenhouses. Florists and veterinary workers, whose pesticide exposure had not been described until now, were also indirectly exposed to pesticides used for former pest control operations. Overall, general population was exposed to more various pesticides and at levels sometimes higher than in occupational places. The most frequent pesticides in residences were not the same as in US studies but levels were similar. These preliminary results need to be confirmed in a greater number of residences from different parts of the country, in order to better assess pesticide exposure of the general population and its influencing factors.

Keywords: Pesticides; Indoor air; Cutaneous exposure; Human exposure assessment; General population; Occupational exposure

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1. Introduction

Pesticides belong to a wide group of chemicals of growing public health concern. Indeed, leukemia, non-Hodgkin's lymphoma and other cancers (Infante-Rivard and Sinnett, 1999; Meinert et al., 2000; Hardell et al., 2002; Richter and Chlamtac, 2002; De Roos et al., 2003), neurologic pathologies (Baldi et al., 2003a,b; Elbaz et al., 2004), respiratory symptoms (Salameh et al., 2003) and hormonal and reproductive abnormalities (Weidner et al., 1998; Bell et al., 2001; Garry et al., 2002, 2003) have been associated with pesticide exposure, mostly in case-control and ecological studies.

A great number of pesticide compounds have been found to contaminate water resources, ambient air, fog, rain and soils in numerous studies (Glotfelty et al., 1987; Richards et al., 1987; Huskes and Levsen, 1997; Albanis et al., 1998; Coupe et al., 2000; Foreman et al., 2000; Majewski et al., 2000; Sanusi et al., 2000). They also contaminate indoor environment, as a consequence of indoor as well as outdoor uses, for occupational and residential purposes. Indeed, outdoor contaminants can be tracked in by shoes, clothes and air drift (Lu et al., 2000; Lewis et al., 2001; Curl et al., 2002; Thompson et al., 2003). Domestic pesticide uses include pet treatments, extermination of household pests, removal of lice, and garden and lawn treatments. Professional uses include crop, greenhouse, cattle and pet treatments, but also pest control operations in buildings.

Pesticide exposure of indoor workers, and specifically exposure of greenhouse workers, has been assessed in numerous studies, by means of static and personal air samplers, skin pads and hand wipes or washes (Brouwer et al., 1993; Aprea et al., 1999, 2001, 2002).

Considering the general population, exposure studies have already been conducted in different countries, including residential and personal measurements (Whitmore et al., 1994; Dingle et al., 1999; Gordon et al., 1999; Adgate et al., 2000; Berger-Preiss et al., 2002; Clayton et al., 2003; Whyatt et al., 2003). They showed that people were exposed at home to various insecticides, such as organochlorines, organophosphates and pyrethroids and also to wood preservatives and some herbicides and fungicides. However, only three studies investigated exposure to such a great variety of pesticides (Whitmore et al., 1994; Clayton et al., 2003; Wilson et al., 2003) and only three performed indoor air and cutaneous measurements (Gordon et al., 1999; Lioy et al., 2000; Wilson et al., 2003). Moreover, none evaluated exposure to different chemical classes of pesticides of the general population in France.

Therefore, our purpose was to assess the exposure of non-occupationally exposed adults living in the Paris area to selected insecticides, herbicides and fungicides, and to compare it to the exposure of a few professionals working indoors and generally assumed to be more exposed. The choice of the working areas was based upon their potential exposure in relation to the exposure of the general population (i.e., jobs related to pet and flower treatments).

2. Materials and methods

2.1. Study population

All the locations studied were in Paris or its suburbs. Forty-one subjects aged more than 18 years were recruited, 37% males and 63% females, with a mean age of 34 ± 9 years. Sampling was performed from February to December 2002. Two different public greenhouses (5 gardeners), three different flower shops (7 florists) and three different services of a Veterinary School (9 veterinarians or veterinary workers) were investigated. The other sites were composed of residences ($n = 12$ flats and $n = 7$ houses with garden) where the inhabitants were non-occupationally exposed to pesticides ($n = 20$ unexposed persons). These unexposed subjects were members of the laboratory staff or employees from civil service or business services. An in-person interview was taken at home to gather information on pesticide uses during the past year.

Each participant gave written informed consent before participation in the study.

2.2. Sampling methods

The sampling method for indoor air was based upon the ASTM D 4861-00 Standard (ASTM, 2000). Indoor air was sampled by using a MiniPartisol air sampler 2100 (Rupprecht and Patashnik, East Greenbush, NY, USA) and a glass cartridge containing a polyurethane foam (PUF), ref. 226-92 (SKC, Blandford Forum, UK) for the collection of aerosols and a QM-A 1851 quartz fiber filter (Whatman, Maidstone, UK) for the collection of particulate matters. The MiniPartisol was placed on a table or working furniture at a height of approximately 1.60 m, in the main room of the workplace or in the living-room of the residences. Flow rate of the pumps was checked before and after each sampling with a mini-Buck Calibrator debitmeter (A.P.Buck, Orlando, FL, USA). The sampling lasted 24 h without interruption at a flow rate of 5 L/min; the mean volume sampled was 7.1 m^3/24 h. Sampling was performed during a working