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Chemosphere 62 (2006) 1917–1924

CHEMOSPHERE

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Environmental and lifestyle factors for organochlorine exposure among women living in Southern Spain

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Received 27 April 2005; accepted 1 July 2005
Available online 8 September 2005

Abstract

Southern Spain has the largest area of intensive greenhouse agriculture in Europe, and may constitute a special case of occupational and female exposure, because this type of farming requires considerable pesticide use and employs many women. We measured adipose tissue levels of 14 organochlorine pesticides in 458 women living in this area and analyzed the relationship between pesticide level/presence and sociodemographic characteristics, reproductive history or life-style factors that may influence this exposure. Pesticide presence was determined by gas chromatography with electron-capture detector. All fat samples were positive for $\geqslant 1$ residue. DDT or metabolites were found in 98.25%, with mean value of 660 ng g^{-1} of lipid. *p,p′*-DDE level was higher in women who were older, with lower educational level or obese. Almost 70% had measurable levels of endosulfan and/or metabolites, with a mean total value of 38.8 ng g^{-1} of lipid. Endosulfan-I exposure was higher in women with shorter residence in rural settings and more frequent in women with $\geqslant 3$ children. 52.62% were exposed to $\geqslant 1$ of aldrin–dieldrin–endrin group. Endrin was more frequent in women who were younger, with higher educational level or no agricultural working experience; dieldrin was more frequent in women who were older, with lower educational level or more children. Finally, lindane residues were found in 39.30%. Lindane levels were higher in women who breastfed longer or had more children. Research is required on women occupationally exposed to a selected group of organochlorine pesticides, especially those of reproductive age, as a basis for preventive action.

Keywords: Pesticides; Exposure; Women; Lifestyle

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doi:10.1016/j.chemosphere.2005.07.024

1. Introduction

Some of the organochlorine pesticides that persist in the environment are endocrine disrupting chemicals. They are of a special interest because their widespread use has been followed by reports of their ubiquitous persistence in different environmental media, of their ability to bioaccumulate and biomagnify in food chains, and of their capacity for long-range atmospheric transport. Although industrialized nations have restricted or banned many of these organochlorine pesticides, they continue to be manufactured for export to other countries. In Spain, the use of some organochlorine pesticides was restricted in the mid-1980s but recent reports show a persistence of pesticide residues in food (Ariño et al., 1995; Porta et al., 1999) and detectable concentrations of organochlorines have been observed in 80–100% of the Spanish population (Van't Veer et al., 1997; Olea et al., 1999; Porta et al., 1999; Sala et al., 1999; Campoy et al., 2001; Rivas et al., 2001; Porta et al., 2002). These pesticides can still be employed for vector control in some neighboring countries (Environmental Protection Agency, 2002) and as an intermediate in the manufacture of pesticides currently produced and used in Spain, such as dicofol (Di Muccio et al., 1988; Porta et al., 2002).

The presence of DDT and metabolites, endosulfan-I and -II and metabolites, aldrin, dieldrin, endrin, and lindane was recently investigated by our group in adipose tissue and blood samples from the female population of Southern Spain (Botella et al., 2004). A significant relationship was found between the serum and adipose tissue concentrations of some of the compounds determined (DDT and endosulfans) but not of all the residues, raising some doubts about the equivalent use of fat/serum samples for assessing exposure to some pesticides in epidemiological studies.

Botella and coworkers reported detectable concentrations of *p,p′*-DDE in 100% of adipose tissue and serum samples and the presence of endosulfan and metabolites in adipose tissue in 156 out of the 200 women from Southern Spain studied (Botella et al., 2004). This organochlorine pesticide is still employed in Spain (Olea and Olea-Serrano, 1996; Olea et al., 1999) and was monitored in the study population because of its widespread use in Europe (Rufingier et al., 1999; United Nations Economic Commission for Europe) and the common finding of their residue in fruit and vegetables in Europe (Arrebola et al., 2001; EU Endosulfan Preliminary Dossier, 2003; Fernandez et al., 2004). Aldrin–dieldrin–endrin were also found in 40% of the women in the same study (Botella et al., 2004). Even though the environmental and agricultural use of these chemicals is prohibited, residues are frequently found in the environment. This is the case with lindane, a widely used pesticide in Spain in the past (Gomez-Catalán et al., 1993; Porta et al., 2002), which was also found in the adipose tissue of 39.3% of the same group of women. Lindane is still permitted in the formulation of pharmaceuticals and for indoor applications (United Nations Economic Commission for Europe).

The aim of the present study was to determine the residue levels of 14 organochlorine pesticides in the adipose tissue of 458 women living in agricultural areas of Southern Spain that has the largest area of intensive greenhouse agriculture in Europe, constituting a special case of occupational and female exposure. We focused on adipose tissue, because adipose tissue levels have been preferentially used as an indicator of historical human exposure to organochlorine pesticides. We expanded the work of Botella and coworkers, increasing the sample size and analyzing the relationship between the level or presence of pesticides in adipose tissue and environmental and/or life-style factors that may influence this exposure.

2. Material and methods

2.1. Study population

The study included 458 women undergoing surgery for various diseases, with an age range of 33–75 years. Total number of recruited women was 612 with a percentage of participation of 74.8%. Twenty-four women did not participate because the interview was not possible during their hospital stay or because of the absence or inadequacy of the adipose tissue sample. All participants signed their informed consent. Structured face-to-face interviews were conducted at the hospitals by trained interviewers to gather data on sociodemographic characteristics, reproductive history, and life-style factors. The rural or urban setting of the patients was recorded as percentage of rurality, calculated as the total number of years lived in a rural setting (<10 000 inhabitants) divided by the age in years. Women with a percentage of rurality >50% were considered to come from a rural setting.

2.2. Biological samples

Adipose tissue samples were collected during surgery in the three largest public hospitals serving Granada and Almeria provinces in Southern Spain. Adipose tissue was placed in a glass vial on ice, coded, and frozen to −70 °C, always within 30 min of being excised and stored at the same temperature in the Laboratory of Medical Investigations until they were processed.

2.3. Reagents

All solvents used were of high purity grade for HPLC: methanol, 2-isopropanol, hexane, and ethanol (Panreac, Barcelona, Spain). The chemicals used (and