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Exposure to pesticides and time to pregnancy among female greenhouse workers

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Abstract

The aim of the study was to evaluate the possible effect of maternal work in greenhouses, as characterised by potentially high exposure to pesticides, on female fertility. Nine hundred and ten women active in 34 greenhouse flower growing enterprises in 1998–2000, with at least one pregnancy, and aged less than 50 years were identified. Seven hundred and seventeen (79%) agreed to be interviewed and reported 1699 pregnancies, of which 713 had complete information on time to pregnancy and occupation. These pregnancies were classified as exposed or non-exposed according to the maternal occupation in greenhouses at the moment of conception and analysed using logistic regression and survival analysis methods. We found a slightly higher proportion of pregnancies with delayed conception (more than 6 months) in the exposed group. However, after adjustment for confounding variables, the estimated hazard ratio for reduced fertility among the exposed was not significantly different to that of the non-exposed pregnancies (HR = 0.96, 95%CI: 0.81, 1.13). A significant reduction in fecundability was observed in older women and with a daily consumption of one or more alcoholic beverages or cups of tea.

Keywords: Fecundability; Time to pregnancy; Women workers; Greenhouses; Pesticide exposures

That exposure to pesticides may interfere with human reproduction was first reported for male workers exposed to dibromochloropropane (DBCP) more than 20 years ago [1]. In the years that followed, many studies investigated other pesticide exposures among both male and female workers. In general, the studies among male workers confirmed the negative effects of pesticide exposure on different parameters of reproductive health, including sperm damage [2,3], male subfecundity [4,5] and even spontaneous abortion in the wives of exposed males [6].

Investigations on women with high exposure to pesticides and their reproductive outcome are not numerous, but negative effects, such as spontaneous abortions, congenital defects and prematurity have been suggested in some studies [7–12].

Infertility and subfecundity among female workers exposed to pesticides have been studied through the endpoint of fecundability known as "time to pregnancy" (TTP), which is considered a sensitive clinical marker of multiple early adverse reproductive effects. However, the results of these studies have been inconsistent.

Delay in conception has been observed among women working in agricultural occupations [13], among those living near a farm [14], and among those handling herbicides and fungicides [15]. However, the Ontario Farm Family Study found no consistent pattern for the association between pesticide exposure and TTP [16]. Furthermore, no statistically significant association was found in a multicenter study in France and Denmark, although greenhouse workers had a longer TTP, especially in their first pregnancies [17].

In other studies greenhouse workers have been shown to be more likely to suffer adverse reproductive effects, perhaps because their exposure to pesticides is higher and more continuous [18]. In addition, greenhouse work is associated with high exposures, not only during the application of pesticides but also during re-entry activities [19,20]. A study among the members of the Danish Gardeners Trade Union showed that female greenhouse workers handling cultures without protection experienced a significant reduction in fecundability [21]. A reduction

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in fecundability was also observed in the wives of male greenhouse workers in Italy [22] and Finland [23], although in the latter case, the reduction was not statistically significant.

In the framework of a retrospective follow up study on reproductive health, mainly spontaneous abortion, among female greenhouse workers in Italy, we have obtained complete reproductive and work histories for the period 1990–1999. This data set provides an opportunity to investigate further whether maternal occupational activities in greenhouses may affect female fecundability as measured by TTP.

1. Materials and methods

1.1. Study population

This study is based on the data obtained from women working in 34 enterprises that cultivated flowers in greenhouses in 2000–2001. These enterprises were located in the province of Ragusa (3 large enterprises), in a small municipality in the province of Rome (1 enterprise), and in the province of Lucca (30 family-run enterprises). The enterprises located in the province of Ragusa and in the province of Rome were the only large enterprises with employees active in those areas, while the family-run enterprises in the province of Lucca accounted for about 30% of the active enterprises with women engaged in greenhouse activities. Through the personnel registers, we identified 1884 women working for at least 6 months in greenhouses during the period 1998–2000. In the first phase of the study, a short questionnaire was administered to all the women to gather information on their age and reproductive history and ask their consent to be interviewed. These preliminary data were used to identify all 910 women aged less than 50 years and with at least one pregnancy that occurred between 1990 and 1999 (inclusion criteria); of them 717 women agreed to be interviewed (response rate = 78.8%). This group reported a total of 1699 pregnancies, of which 655 were excluded because they occurred prior to 1990. Of the remaining 1044 pregnancies, 49 were excluded because they ended with an induced abortion. Two hundred and ten pregnancies, conceived while the couples were using contraception, were also excluded since it was not possible to define their TTP. Another 60 pregnancies were excluded because the women could not provide information on the TTP, and 12 because the information on exposure during the period of interest was missing. The analysis used the remaining 713 pregnancies for which there was complete information. The flowchart in Fig. 1 shows the process of selection of the pregnancies included in the analysis.

1.2. Data collection

A questionnaire was administered in person by trained interviewers. Participating women were asked to provide the following information for each of their pregnancies occurring during the study period: month and year in which the pregnancy ended; use of contraceptive methods before conception; time (in months) that elapsed between the beginning of unprotected intercourse and conception (time to pregnancy or TTP); pregnancy outcome; a description of the activities performed at work before and during the pregnancy, including the use of chemical products and smoking before conception; consumption of alcohol, coffee and tea were only collected for the first trimester of pregnancy. Analogous occupational information was collected from the woman with respect to the father.

1.3. Exposure assessment

We have defined as "exposed" to pesticides, the women who worked in the greenhouse in the month when conception took place, assuming that exposure during this month is probably representative of the exposure during the entire time when the women were trying to conceive. This assumption is justified considering that the 77% of the exposed women had worked full time for at least 1 year before conception. Moreover, their main activities involved manual handling of the plants such as weeding, cutting, sorting and packaging of produce. As shown in previous studies, these activities involve primarily dermal exposure

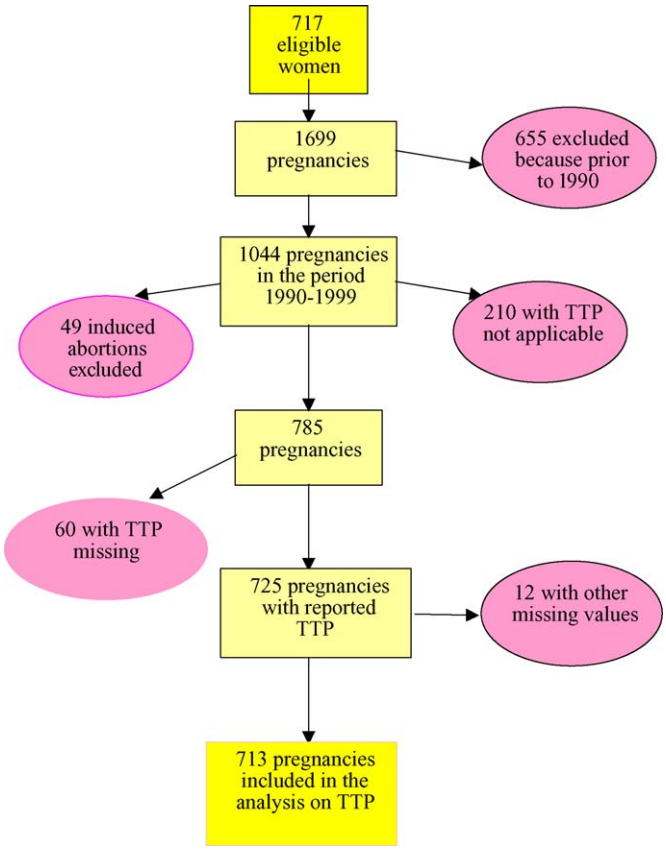

Fig. 1. Selection of the study population for the analysis of exposure and TTP.

from direct contact with foliar residues [20]. Since treatments are repeated every few weeks, it is likely that women trying to conceive were exposed to pesticides for at least part of their TTP. The main products used are shown in Table 1. This information was collected directly from the greenhouse owners in a preliminary contact for the study. Women were unable to provide information on exposure to specific pesticides.

1.4. Data analysis

In the present report, we present the proportion of women with TTP greater than 6 months according to exposure status. Some potential biological and social confounders have been taken into account in the statistical analysis. These include mother's and father's age at conception, parity, father's work in agriculture during 6 months before the pregnancy, mother's smoking before conception, and her consumption of alcohol, tea and coffee during the first trimester of pregnancy, which was assumed to represent the level of consumption before the pregnancy.

We calculated the proportions of women with TTP greater than 6 months and the odds ratios. We used Kaplan–Meier survival curves to compare the TTP between the two exposure groups. Cox regression models were used to estimate the association between TTP and greenhouse activity through the crude and the adjusted hazard ratio (HR). The analyses were performed using the statistical software STATA.

2. Results

Table 2 shows selected maternal and paternal characteristics by the length of TTP (less or more than 6 months). The last column of the Table shows the crude ORs for delay beyond 6 months in association with the work of the mother in greenhouse at the time of conception, mother's and father's age,