Chemosphere 137 (2015) 185–191

Contents lists available at ScienceDirect

Chemosphere

journal homepage: www.elsevier.com/locate/chemosphere

Biological monitoring of Persistent Organic Pollutants in human milk in Israel

Janice Wasser [a,*], Tamar Berman [a], Liat Lerner-Geva [b,d], Itamar Grotto [a], Lisa Rubin [a,c]

[a] Public Health Services, Ministry of Health, Israel, 39 Yirmiyahu St., P.O. Box 1176, Jerusalem 9101002, Israel
[b] Women and Children's Health Research Unit, Gertner Institute for Epidemiology & Health Policy Research (Ltd), Tel Hashomer 52621, Israel
[c] School of Public Health, Haifa University, 199 Aba Khoushy Ave., Mount Carmel, Haifa 3498838, Israel
[d] School of Public Health, Sackler Faculty of Medicine, Tel Aviv University, Tel Aviv 6997801, Israel

HIGHLIGHTS

- Levels of POPs exposure in Israel have declined significantly in the last 30 years.
- For POPs found at detectable levels in Israel, most were lower than reported in Europe.
- Aldrin, endrin, and mirex were not found at detectable levels in the pooled sample.
- Baseline measures were established for dioxins and furans in human milk for Israel.

ARTICLE INFO

Article history:
Received 20 January 2015
Received in revised form 19 April 2015
Accepted 12 July 2015
Available online 31 July 2015

Keywords:
Persistent Organic Pollutants
Pesticides
Brominated flame retardants
Biomonitoring
Breast milk

ABSTRACT

Background: The Stockholm Convention on Persistent Organic Pollutants (POPs) aims to eliminate or restrict the production and use of POPs around the globe. The Ministry of Health, collaborating with the Ministry of Environmental Protection, measured the exposure of the population to POPs as part of the WHO-coordinated exposure study. Human milk, with a relatively high fat content is a preferred matrix for the monitoring of exposure.
Methods: Donors of breast milk were recruited from three hospitals after signing informed consent forms. Breast milk was collected from 52 primipara women, aged 23-35, living in Israel for the last 10 years who gave birth to singleton full term healthy infants. Samples, collected at 3-17 weeks postpartum, were stored at -20 °C until sent to the WHO Reference Laboratory, State Laboratory for Chemical and Veterinary Analysis of Food (CVUA), in Frieburg, Germany for a single pooled analysis. Mothers were provided with the pooled analysis results.
Results: Out of over 50 Persistent Organic Pollutants listed in the analysis, 16, including aldrin, endrin, parlar and mirex were not found at detectable levels in the Israeli pooled sample. For the indicator compounds found at detectable levels, most were lower than those reported in European countries.
Discussion: Since 1982, levels of POPs contamination as measured in breast milk have declined significantly. This is likely due to restrictions on agricultural, industrial, and other uses of many POPs in Israel. Ongoing biomonitoring in Israel and inter-ministerial collaboration supports the elimination of POPs in the environment and human milk.

1. Introduction

Persistent Organic Pollutants (POPs) are man-made organic non-volatile compounds that are resistant to environmental degradation through chemical, biological, and photochemical processes. This category of compounds includes organochlorine pesticides such as DDT, industrial chemicals such as polychlorinated biphenyls (PCBs), and unintentionally generated POPs such as polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). Human exposure to POPs through the food chain has been associated with endocrine disruption, poor reproductive outcomes and insulin resistance and selected POPs (PCBs, 2,3,7,8 TCCD) are classified as definite or probable human carcinogens (UNEP, 2013).

* Corresponding author.
E-mail addresses: janice.wasser@gmail.com (J. Wasser), tamar.berman@moh.health.gov.il (T. Berman), LiatL@gertner.health.gov.il (L. Lerner-Geva), itamar.grotto@moh.health.gov.il (I. Grotto), lisa.rubin@moh.health.gov.il (L. Rubin).

http://dx.doi.org/10.1016/j.chemosphere.2015.07.038
0045-6535/

The goals of this survey include monitoring POPs in human milk to evaluate effectiveness of steps taken in individual countries to reduce exposure to POPs, and to gather information for assessment and management of public health risk"

The Stockholm Convention on POPs is an international environmental treaty that aims to eliminate or restrict the production and use of POPs (UNEP, 2010a,b, http://chm.pops.int). Upon joining the Organization for Economic Co-operation and Development (OECD) in 2010, Israel committed to a range of actions in the field of chemical registration and regulation. One of these actions was ratifying the Stockholm Convention. The present survey was performed as part of the national implementation plan as required by the Convention.

Environmental chemicals included in the study were selected on the basis of the protocol described in the Fourth WHO-Coordinated Survey of Human Milk for Persistent Organic Pollutants in Cooperation with United Nations Environment Program (UNEP) manual published in 2007 as part of the Stockholm Convention.

The revised WHO guidelines provide a national protocol establishing the study design to monitor human exposure over time in order to, among other things, evaluate effectiveness of the Stockholm Convention in reducing the release of POPs into the environment and population exposure. These guidelines promote continued support to monitor persistent organic contaminants for human health and food-chain contamination purposes (WHO, 2007). Human milk, with a relatively high fat content, is considered to be a preferred matrix for monitoring maternal and infant exposure to POPs.

The purpose of the study was to determine the concentrations of POPs in a pooled breast milk sample for the study population and to compare concentrations with those from a similar analysis which took place 30 years earlier in Israel and with other countries in the World Health Organization (WHO) coordinated survey.

2. Study methods

2.1. Recruitment of study participants

A total of 92 women were recruited for the study from May 2011 to July 2012 as a convenience sample from three medical centers in the central region of Israel. Visits were made to the hospitals in coordination with the lactation consultants who offer lectures on breastfeeding several times a week. The potential donors were phoned a month later to determine if there was still interest in participating in the survey. Each recruit was provided with a kit which included the collection bottle, specific instructions on breast milk expression and storage, two booklets on breastfeeding support and a small gift for the infant with the logo promoting breastfeeding. The parameters for inclusion in the study were (1) primiparae; (2) under 35 years of age; (3) singleton birth; (4) apparently healthy (both mother and child), including normal pregnancy and delivery; (5) residing in Israel for at least the previous 10 years; (6) not residing in areas where emissions of POPs are known or suspected to result in elevated levels of POPs in the local population; (7) available for sample collection up to 2 months after birth.

The geographical distribution of the donors' residences covered an area approximately within a 30 km radius from Tel Aviv (displayed in Fig. 1). This represents the greater Tel Aviv metropolitan area with the highest population density in the country. It was important to sample the population not residing in areas where emissions of POPs are known or suspected to result in elevated levels of POPs. All participants were asked if they lived in highly polluted areas, such as in the vicinity of incinerators, pulp and paper industries and metal industries or where organochlorine substances are produced or used. There were no women excluded from the survey based on markedly high exposure to POPs. All participants were asked if they lived in highly polluted areas, such as in the vicinity of incinerators, pulp and paper industries and metal industries or where organochlorine substances are produced or used. There were no women excluded from the survey based on markedly high exposure to POPs.

A separate request to the Helsinki Committee [equivalent to the Institutional Review Board (IRB)] was made for each of the three hospitals. The approval we received applied to the author (JW) who conducted the interviews with the mothers at the Sheba and Tel Aviv Medical Centers. For Meir Medical Center, approval was received for three staff members (nurses who were also lactation consultants) who conducted the interviews.

The nature and purpose of the survey were explained to the potential donors including the rights of the donor to withdraw from the survey without prejudice. The health benefits of breastfeeding to both mother and baby were communicated to avoid concerns about the quality of human milk. Following this, the donor was requested to give her written consent on a standard *Informed Consent Form* in Hebrew. Sampling of milk for the study was ensured not to be an undue burden on the mother nor did it compromise the nutritional status of the infant.

Participation in the study (providing a sample of breast milk and responding to the survey questionnaire) was voluntary. At the time of recruitment participants received documentation of the study and a letter explaining that they would receive pooled results upon completion of the analysis

2.1.1. Interview and collection of samples

Upon phoning these mothers a month after the birth, 89 (97%) were reached, 53 (58%) donated their breast milk, 33 (36%) either had stopped breastfeeding or had not managed to prepare the sample in time for collection. One sample did not meet the requirement of at least 30 ml therefore it was excluded from the analysis. Only three women refused to participate and three others were lost to follow up.

Study participants were interviewed in their homes using a structured questionnaire when the samples were collected (up to two months after the birth). The interviews were conducted by the national coordinator in Hebrew or in English. The interview consisted of questions covering the following items: (1) review of the parameters for inclusion in the study; (2) demographic data including pre-pregnancy height and weight; (3) food type and frequency table on pre-pregnancy diet; (4) questions regarding occupational and household exposure.

Sample collection was carried out between 4 and 8 weeks (28 days to 2 months) after birth to ensure breastfeeding was well-established. The mothers collected up to 50 ml of milk by hand or pump expression into a sterilized glass jar with a protective screw cap and stored in the home refrigerator at about +4 °C for a maximum of 72 h until they were transported to the centrally located storage freezer (−20 °C) at the Emergency Department of the Ministry of Health.

Jars were labeled with the donor's individual identification code to ensure anonymity. After 13 months of collection, the frozen samples were shipped to the WHO Reference Laboratory, State Laboratory for Chemical and Veterinary Analysis in Food (CVUA), Frieburg, Germany. Shipping was handled by an expedited service at +4 °C (with ice packs) within 48 h.

2.2. Preparation of pooled sample

Up to 50 ml of breast milk was collected from each donor (minimum of 30 ml). Ten ml was taken from each of the individual