OPEN ACCESS

Journal of Toxicology and Environmental Health Sciences

May 2018
ISSN 2006-9820
DOI: 10.5897/JTEHS
www.academicjournals.org

ACADEMIC JOURNALS
expand your knowledge

ABOUT JTEHS

The **Journal of Toxicology and Environmental Health Sciences (JTEHS)** is published monthly (one volume per year) by Academic Journals.

The **Journal of Toxicology and Environmental Health Sciences (JTEHS)** is an open access journal that provides rapid publication (monthly) of articles in all areas of the subject such as toxic genomics, enzyme inhibition, drug overdose, Children's Environmental Exposure Research Study etc.

The Journal welcomes the submission of manuscripts that meet the general criteria of significance and scientific excellence. Papers will be published shortly after acceptance. All articles published in JTEHS are peer-reviewed.

Contact Us

Editorial Office: jtehs@academicjournals.org

Help Desk: helpdesk@academicjournals.org

Website: http://www.academicjournals.org/journal/JTEHS

Submit manuscript online http://ms.academicjournals.me/.

Editors

Journal of Toxicology and Environmental Health Sciences

Table of Contents: Volume 10 Number 2 May 2018

ARTICLE

Vol. 10(2), pp. 10-14, May 2018
DOI: 10.5897/JTEHS2018.0409
Article Number: 10E14F857101
ISSN 2006-9820

http://www.academicjournals.org/JTEHS

ACADEMIC JOURNALS

Journal of Toxicology and Environmental Health Sciences

Full Length Research Paper

Organochlorine pesticides contamination in human milk in Abidan (Côte d'Ivoire)

Manda Pierre*, Adepo Aholia Jean-Baptiste and Dano Djédjé Sébastien

Laboratoire de Toxicologie et Agro-industrielle, UFR Sciences Pharmaceutiques et Biologique, Université Felix Houphouêt Boigny, BPV 34 Abidjan, Cote d'Ivoire.

Received 4 March, 2018: Accepted 23 April, 2018

Organochlorine pesticides belong to the class of persistent organic pollutants (POPs). They are deeply involved in environmental issues and represent a real threat for human health. The aim of this study was to assess the level of organochlorine pesticides contamination in human milk through two studies of POPs biomonitoring performed in 2010 and 2015 in Côte d'Ivoire. Primiparous breastfeeding mothers were selected from maternal and child healthcare centers in the district of Abidjan. A grouped human milk sample was prepared from individual sample collected from each mother. The grouped sample was frozen at -20°C, packaged and shipped to a World Health Organization (WHO) reference laboratory in Germany for the determination of persistent organic pollutants. Analysis of samples from both studies revealed the presence of several organochlorine pesticides such as dichlorodiphenyltrichlorethane (DDT), hexachlorocyclohexane (HCH), dieldrin, chlordane, heptachlor and heptachlorobenzene. Some organochlorine pesticides such as DDT (1073 to 491 ng/g) (54.24%), chlordane (5.7 to 3.6 ng/g) (36.84%), heptachlor (4 to 2 ng/g) (50%) and dieldrin (4.6 to 3.3 ng/g) showed an outstanding decrease. However, HCH and heptachlorobenzene increased in human milk from 2010 to 2015. Values increased from 13.8 to 18.2 ng/g for HCH and from 2.6 to 3.4 ng/g for heptachlorobenzene. Despite their ban, humans are still subject to a long term exposure to organochlorine pesticides.

Key words: Organochlorine pesticides, human milk, biomonitoring.

INTRODUCTION

Organochlorine pesticides belong to the class of persistent organic pollutants (POPs). These chemicals are lipophilic molecules and very stable. They are accumulated in body fats of long lived species found at the top of the food chain (Porpora et al., 2016). They are at higher concentrations in food products containing fat such as milk. In humans, POPs and organochlorine pesticides are basically found in breast milk, blood lipids and other tissues (Porta et al., 2008; Waliszewski et al., 2011; Bräuner et al., 2012; Porpora et al., 2013). The commonly found organochlorine pesticides are dichlorodiphenyltrichlorethane (DDT), hexachlorocyclohexane (HCH), chlordane and heptachlor. POPs are deeply involved in environmental

*Corresponding author. E-mail: mandapierre@yahoo.fr. Tel: +225 05 69 87 26.

issues and represent a real threat for human health. Organochlorine pesticides toxicity in humans results in neurological, mutagenic, carcinogenic, teratogenic, and dermatological effects as well as hormonal disorders (Freire et al., 2012; Boccolini et al., 2013). The Ivorian government, being aware of the adverse health effects of POPs on its population and environment signed in 2001 and ratified in 2003 the Stockholm Convention, focusing on measures aimed at implementing a National policy for persistent organic pollutants control.

In 2005, a pilot study on human milk jointly carried out by Global Environment Monitoring System (GEMS/Foods) and the Chemisches und Veterinäruntersuchungsamt (CVUA Laboratory), confirmed the economic efficacy by measuring each of the 12 POPs, major targets of the Stockholm Convention, in grouped samples of human milk. World Health Organization (WHO) and United Nations Environment Programme (UNEP) have jointly set up a memorandum of understanding to coordinate studies on human milk according to the Stockholm Convention. Two national surveys supervised by WHO/UNEP were conducted in October 2010 and December 2015 to determine the presence of POPs in human milk. The aim of this study was to assess the impact of the national policy for POPs biomonitoring in compliance with the Stockholm Convention.

MATERIALS AND METHODS

Selection of subjects

The study was conducted on primiparous breastfeeding mothers birthing only one child (no twins). Mothers who have been living in the region for the last ten years were selected from health centers hosting a Maternal and Child Healthcare Center in the district of Abidjan. Donor mothers were selected by the national coordinator after obtaining their informed consent. A survey sheet on participants' food habits was filled in. For donors who did not speak French, a local language translation was performed by a qualified interpreter.

Sample collection

Fifty milliliters (50 ml) of human milk were manually collected using a breast-pump. The collected sample was immediately put in a container (vial), then sent to the Laboratory of Toxicology at the Department of Biological and Pharmaceutical Sciences of the University of Félix Houphouët Boigny (Côte d'Ivoire) and kept at -20°C during the study.

Treatment of samples

Individual milk samples were homogenized and heated at 38°C in a Bain Marieunder constant stirring for 10 min. The grouped samples were prepared from individual samples of 50 ml collected from sites. 25 ml of each sample was collected and mixed up in a vial of 2,000 ml. A single grouped sample containing 1,250 ml was obtained from 50 individual samples.

Determination of POPs

The grouped sample was frozen at -20°C, packaged and shipped to a WHO reference laboratory in Germany (CVUA, Freiburg, Germany).

RESULTS

Socio-demographic surveys

A total of 50 primiparous mothers were selected to participate in these biomonitoring studies. The mean age of mothers was 21.85±3.08 years in 2010 and 22.20±3.44 in 2015 (Table 1). About 96% in 2010 and 87.75% in 2015 lived in urban areas. All mothers had a varied diet during both studies. They were exposed to domestic insecticides at a rate of 53% in 2010 and 50% in 2015 (Table 1).

Determination of organochlorine pesticides

Analysis of samples from both studies revealed the presence of several organochlorine pesticides such as dichlorodiphenyltrichlorethane (DDT), hexachlorocyclohexane (HCH), dieldrin, chlordane, heptachlor and heptachlorobenzene. Some organochlorine pesticides showed a decrease in concentration from 2010 to 2015, it is the case of DDT (1073 to 491 ng/g; 54.24%), chlordane (5.7 to 3.6 ng/g; 36.84%), heptachlor (4 to 2 ng/g; 50%) and dieldrin (4.6 to 3.3 ng/g) (Figure 1 and 2). However, HCH and heptachlorobenzene increased in human milk from 2010 to 2015. Values increased from 13.8 to 18.2 ng/g for HCH and from 2.6 to 3.4 ng/g for heptachlorobenzene (Figure 2).

DISCUSSION

Many organochlorine pesticides were found in human milk in both studies. However, concentrations of dichlorodiphenyltrichlorethane (DDT) in these studies were higher. Since the signature of the Stockholm Convention in 2001 by the Ivorian government, a series of measures has been implemented for persistent organic pollutants control (MFN, 2006; PSAC, 2012). The different studies jointly conducted by World Health Organization (WHO) and United Nations Environment Programme (UNEP) were to ascertain whether national policies for persistent organic pollutants (POPs) reduction provided outstanding results. Encouraging results were noticed in this study, particularly for DDT, chlordane and heptachlor showing an outstanding decrease in human

Table 1. Socio-demographic parameters.

Particular		Years	
		2010	2015
Samples (n)		50	50
Mean age of mothers (years)		21.85±3.08 [14 – 29]	22.20±3.44 [15 – 29]
Age of breastfed children (weeks)		5.85 [3 – 8]	5.79±2.15 [3.5 – 7.5]
Place of residence for the last ten years	Urban	96%	87,75%
	Rural	4%	12,24%
Varied diet		100%	100%
Exposure to domestic insecticides		53%	50%

The age of mothers in both studies ranged from 14-29 years old with an average of 21.85±3.08 years in 2010 and 22.20±3.44 years in 2015. All mothers had a varied diet.

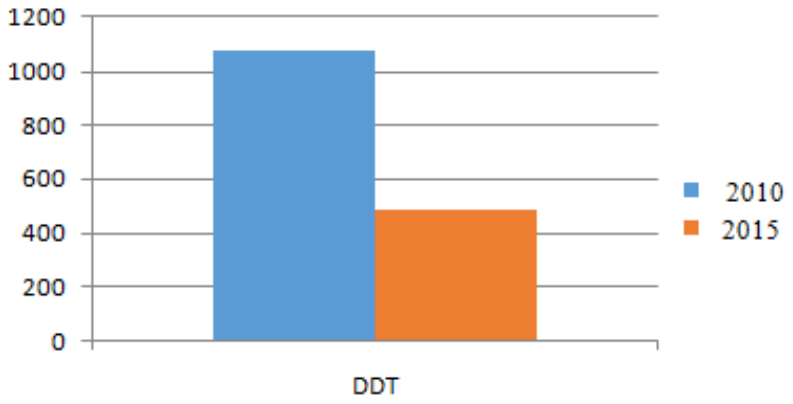


Figure 1. Content of DDT in human milk (ng/g of fatty matter) (WHO compaigns 2010, 2015).

milk. Levels of DDT reduction are so higher as previous studies reported a concentration of 2671.5 ng/g in human milk (Traoré et al., 2002). Restrictions and prohibitions on the use of some organochlorine pesticides were not well followed. As a result, some organochlorine pesticides such as hexachlorocyclohexane (HCH) and heptachlorobenzene have been increasing in human milk. In 1984, Food and Agriculture Organization/World Health Organization (FAO/WHO) established acceptable daily intake of 20 µg/kg/day and 0.1 µg/kg/day for DDT and dieldrin, respectively, in human milk (FAO/WHO, 1985). These values can be converted for DDT to an acceptable level of 5000 to 6000 ng/g in lipids (Smith, 1999). Concentration levels of DDT obtained are below the Ivorian reference values. Surveys of organochlorine pesticides in human milk from developing countries were carried out because of the concern about the use of these compounds for agricultural and sanitary purposes in recent years (Kaunisue et al., 2004). Organochlorine pesticides are all banned in agriculture and public health today. Contamination of organochlorine pesticides in human milk were found in various environmental and food matrices in Côte d'Ivoire such as sediments, foodstuffs and fishes (Traoré et al., 2003, 2008; Ouffoue, 2009; Manda et al., 2017). The widespread contamination of the environment and foods by pesticides inevitably leads to human contamination. The most persistent and lipophilic pesticides possessing bioaccumulation properties are often found in human organs. Breast milk, the first human food, is an indicator in terms of bioaccumulation of pesticide residues in human body (Somogyi and Beck, 1993; Della et al., 2012). Contamination of organochlorine pesticides in human milk is a global phenomenon. Moreover, the levels detected in some parts of the world, such as Africa and Asia, are appalling.

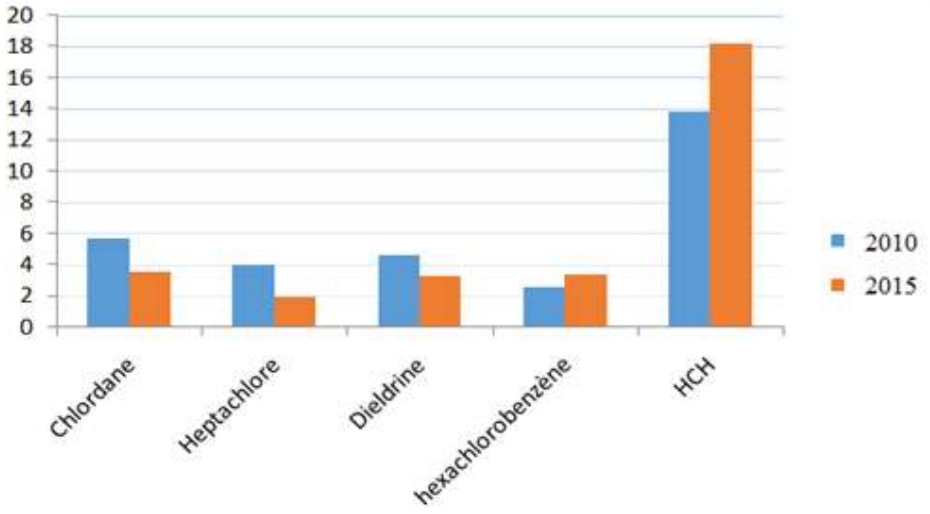


Figure 2. Content of POPs in human milk (ng/g of fatty matter) (WHO campaigns 2010, 2015).

The total DDT level in breast milk is significantly lower than that found in Mali (2081 ng/g) (UNEP-Mali, 2012), in China (1960 ng/g) (Yu et al., 2003), but higher and Libya (220 ng/g) (Zeinab et al., 2011) and India (170 ng/g) (Kumar et al., 2005).

Conclusion

Many organochlorine pesticides banned by the Stockholm Convention have been found in breast milk in Ivory Coast. These organochlorine pesticides were sometimes detected in higher concentrations. These levels highlight the weakness of the implementation of the national policy for persistent organic pollutants (POPs) control. A rigorous implementation of texts and conventions signed by the Ivorian government should be a priority. Further monitoring of human milk is necessary to determine whether the observed outbreak of organochlorine pesticides is due to a previous contamination or to a new source of exposure.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

Boccolini PMM, Boccolini CS, Meyer A, Chrisman JR, Guimarães RM, Veríssimo G (2013). Pesticide exposure and low birth weight prevalence in Brazil. International Journal of Hygiene Environmental Health, 216(3):290-294.

Bräuner EV, Sørensen M, Gaudreau E, Leblanc A, Eriksen KT, Tjønneland A, Overvad K, Raaschou-Nielsen O (2012). A prospective study of organochlorines in adipose tissue and risk of non-Hodgkin lymphoma. Environmental Health Perspectives, 120(1):105.

Della CLS, Migoya C, Capelletti N, Gomez G, Arozamena D, Madelón Sobral et al (2012). Contaminantes orgánicos persistentes en leche materna de centros urbanos de la provincia de Buenos Aires. Augmdomus 4:92-102,

FAO/WHO (1985). Pesticide residues in food : 1984, report of the Joint Meeting on Pesticide Residues, Rome, 24 September - 3 October 1984. Rome: FAO.Available at: http://apps.who.int/iris/handle/10665/38174

Freire C, Koifman RJ, Sarcinelli P, Rosa AC, Clapauch R, Koifman S (2012). Long term exposure to organochlorine pesticides and thyroid function in children from Cidade dos Meninos, Rio de Janeiro, Brazil. Environmental Research, 117:68-74.

Kumar A, Dayal P, Shukla G, Singh G, Joseph PE (2005). DDT and HCH residue load in mother's breast milk: A survey of lactating mother's from remote villages in Agra region. Environment International, 32(2):248-251.

Kunisue T, Someya M, Kayama F, Jin Y, Tanabe S (2004). Persistent organochlorines in human breast milk collected from primiparae in Dalian and Shenyang, China. Environmental Pollution, 131(3):381-392.

Manda P, Adepo AJ, Goze NB, Dano DS (2017). Assessment of Human and Ecosystem Contamination by Organochlorine Pesticides in Cote d'Ivoire. Advanced Journal of Toxicology Current Research, 1(2):094-099.

Ouffoue Koffi S, Ahibo Coffy A, Villeneuve JP, Sess DE, N'Guessan YT (2009). Pollution of a Tropical Lagoon by the Determination of Organochlorine Coumpounds. Tropicultura, 27(2):77-82.

Plan national de mise en œuvre de la convention de Stockholm sur les polluants organiques persistants (PNM) (2006). Ministère de l'Environnement, des Eaux et Forêts, Abidjan, Côte d'Ivoire, P 147.

Plan de gestion des pestes et pesticides en Côte d'Ivoire **(**PSAC) (2012). Rapport final. P 55.

Porpora MG, Lucchini R, Abballe A, Ingelido AM, Valentini S, Fuggetta E (2013). Placental transfer of persistent organic pollutants: a preliminary study on mother-newborn pairs. International Journal of Environmental Research and Public Health, 10(2):699-711.

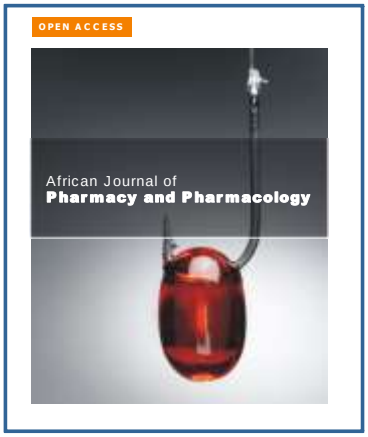
Porpora MG, Serena RS, Fuggetta EE (2016). Organochlorine pesticides exposure & preterm birth. . The Indian Journal of Medical Research, 143(6):685.

Porta M, Puigdomènech E, Ballester F, Selva J, Ribas-Fitó N, Llop S, López T (2008). Monitoring concentrations of persistent organic

pollutants in the general population: the international experience. Environment International, 34(4):546-561.
Smith D (1999). Worldwide trends in DDT levels in human milk. International Journal of Epidemiology, 28(2):179-188.
Somogyi A, Beck H (1993). Nurturing and breast-feeding: exposure to chemicals in breast milk. Environmental Health Perspectives, 101(Suppl 2):45.
Traoré SK, Dembele A, Mamadou K, Mambo V, Lafrance P, Bekro Y A (2008). Control of organochlorine pesticides in milk and milk products: Bioaccumulation and risk of exposure. Afrique Science: Revue Internationale des Sciences et Technologie, 4(1).
Traoré SK, Mamadou K, Dembele A, Lafrance P, Banton O, Houenou P (2003). Comparative study of the level of organochlorine pesticide residues in three species of fi sh from Lake Buyo (south-west of Cote d'Ivoire) and estimation of the potential risk for human health. Journal de la Société ouest-africaine de chimie, (16):137-152.
Traoré SK, Mamadou K, Dembele A, Lafrance P, Banton O, Houenou P (2002). Organochlorine pesticide residues in human milk from an agricultural area of Cote d'Ivoire. Journal de la Société ouest-africaine de chimie, 13:99-109.
UNEP-Mali (2012). Supporting the global monitoring plan on persistent organic pollutants. West African region project GFL 4A76, Rapport national. P 29.
Waliszewski SM, Caba M, Herrero-Mercado M (2011) Monitoring of organochlorine pesti-cide residue levels in adipose tissue of Veracruz, México inhabitants. Bulletin of Environmental Contamination and Toxicology, 87(5):539-544.
Yu H, Zhu Z, Zhang X, Wang D (2003). Levels of organochlorine pesticides in Beijing human milk. Bulletin of Environmental Contamination and Toxicology, 70(2):0193-0197.
Zeinab HM, Refaat GA, El-Dressi AY (2011). Organochlorine pesticide residues in human breast milk in El-Gabal Al-Akhdar, Libya. In International Conference on Life Science and Technology IPCBEE. Singapore: IACSIT Press.

.

Related Journals:



www.academicjournals.org