Available online at www.sciencedirect.com

SCIENCE DIRECT®

Science of the Total Environment 359 (2006) 90–100

Science of the Total Environment
An International Journal for Scientific Research into the Environment and its Relationship with Humankind

www.elsevier.com/locate/scitotenv

Fish intake and serum levels of organochlorines among Japanese women

H. Tsukino[a], T. Hanaoka[a,*], H. Sasaki[b], H. Motoyama[b], M. Hiroshima[b], T. Tanaka[b], M. Kabuto[c], W. Turner[d], D.G. Patterson Jr.[d], L. Needham[d], S. Tsugane[a]

[a]*Epidemiology and Prevention Division, Research Center for Cancer prevention and Screening, National Cancer Center 5-1-1 Tsukiji, Chuo-ku, Tokyo 104-0045, Japan*
[b]*Department of Obstetrics and Gynecology, Jikei University School of Medicine, 3-25-8 Nishishinbashi, Minato-ku, Tokyo 105-8461, Japan*
[c]*National Institute for Environmental Studies, 16-2 Onogawa, Ibaragi, Tsukuba, 305-0053, Japan*
[d]*Division of Laboratory Sciences, National Center for Environmental Health, Centers for Disease Control and Prevention, 4770 Buford Hwy, F-17, Atlanta, Georgia 30341-3724, USA*

Received 24 August 2004; accepted 20 April 2005

Abstract

This study evaluates background serum levels of selected organochlorine compounds among Japanese women of reproductive age and investigates whether lifestyle factors, especially dietary factors, may be associated with these levels. A cross-sectional study was performed on 80 Japanese women, aged 26–43 years, who complained of infertility and were confirmed not to have endometriosis. The serum levels of total toxic equivalency (TEQ), 18 polychlorinated dibenzo-*p*-dioxins (PCDDs)/polychlorinated dibenzofurans (PCDFs), 4 coplanar polychlorinated biphenyls (cPCBs), 36 *ortho*-substituted polychlorinated biphenyls (PCBs), and 13 chlorinated pesticides or their metabolites were measured and data were collected on the women's age, residence, occupation, body mass index (BMI), smoking and alcohol habit and 6 dietary intakes (fish, meats, rice, vegetables, fruits and dairy products). The serum median level of total TEQ was 25.1 pg TEQ/g lipid, that of PCDDs/PCDFs/cPCBs was 11.5 pmol/g lipid, that of PCBs was 0.46 nmol/g lipid, and that of total pesticides was 1.32 nmol/g lipid. The serum levels of total TEQ, PCDDs/PCDFs/cPCBs, PCBs and pesticides were positively associated with age (P for trend = 0.003, 0.01, 0.005 and 0.01, respectively) and frequent fish consumption (P for trend = 0.002, 0.003, 0.0003 and 0.006, respectively). Other lifestyle factors were not associated with serum organochlorine levels. The present study suggests that Japanese women who consume fish frequently in their reproductive period tend to accumulate organochlorines in their bodies.

Keywords: Fish intake; Organochlorines; Dioxins; Polychlorinated biphenyls; Pesticides; DDT

* Corresponding author. Tel.: +81 3 3547 5201x3391; fax: +81 3 3547 5878.
E-mail address: thanaoka@gan2.res.ncc.go.jp (T. Hanaoka).

0048-9697/$ - see front matter © 2005 Elsevier B.V. All rights reserved.
doi:10.1016/j.scitotenv.2005.04.014

1. Introduction

Many environmental organochlorine pollutants including polychlorinated dibenzo-*p*-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), coplanar polychlorinated biphenyls (cPCBs), *ortho*-substituted polychlorinated biphenyls (PCBs) and chlorinated pesticides have the potential to mimic or antagonize naturally occurring hormones and might affect wildlife and humans adversely (Kavlock et al., 1996; Wolff et al., 1993). PCDDs and PCDFs were unintended byproducts of several industries and processes: the herbicide industry, the chlorine and paper industry, melting processes and incineration of waste. More than 80% of total PCDDs and PCDFs released into the environment in Japan have been estimated to be derived from incinerators (Watanabe et al., 1999). PCBs and pesticides were used in industry and agriculture until the early 1970s. These organochlorines are resistant to metabolism and are lipid soluble; they bioaccumulate in the food chain, and are found in human adipose tissue, blood, and breast milk (Safe, 2000). Human exposure to organochlorines occurs almost exclusively through food consumption. Various kinds of fish from several supermarkets in Japan were reported to contain high levels of PCDDs, PCDFs and PCBs, and the mean daily intake of total toxic equivalency (TEQ) values of PCDDs, PCDFs and PCBs from fish and shellfish were higher than that from other foods (Tsutsumi et al., 2001). The main foods contributing to dietary intake of chlorinated pesticides including total hexachlorocyclohexane (HCH) and total bis(4-chlorophenyl)-1,1,1-trichloroethane (DDT) have been also reported to be fish and meat among the Japanese population (Nakagawa et al., 1995). These findings suggest that people who often consume fish or meat would accumulate higher levels of PCDDs, PCDFs, PCBs and pesticides in their body.

In the present study, we measured serum levels of organochlorines including 8 PCDDs, 10 PCDFs, 4 cPCBs, 36 PCBs, and 13 chlorinated pesticides or their metabolites in 80 Japanese infertile women in a hospital-based cross-sectional study. The object of the present study was to evaluate background levels of exposure to organochlorines in Japanese women of reproductive age, and to estimate the effect of lifestyle factors, especially dietary factors, on serum organochlorine levels.

2. Subjects and methods

2.1. Subjects and sample collection

Eligible subjects were women aged 20 to 45 years who complained of infertility and consulted doctors in the Department of Obstetrics and Gynecology, the Jikei University School of Medicine, from 1999 to 2000. A total of 139 women were diagnosed laparoscopically according to the revised classification of the American Fertility Society (1985). Fifty-eight women with stage II or greater endometriosis were designated 'cases.' Eighty-one women who were laparoscopically confirmed not to have endometriosis (stage 0 or I) were designated 'controls.' Because accumulation of organochlorines in the body has been proposed as a risk factor for endometriosis (Rier et al., 1993), endometriosis cases might present higher serum organochlorine levels. Of eighty-one control subjects, we excluded one subject whose serum PCB levels could not be measured because of small blood sample volume. Consequently, eighty subjects, aged 26–43 (mean age, 32.9 years), were included in this study. All subjects gave their written informed consent. The study protocol was approved by the Institutional Review Board of the Jikei University School of Medicine, National Cancer Center, National Institute for Environmental Studies, and U.S. Centers for Disease Control and Prevention (CDC).

A fasting blood sample was obtained before the laparoscopic examination. Serum was immediately collected by centrifugation, transferred into a stock tube and stored at −80 °C until analyzed.

2.2. Questionnaire survey

Subjects were interviewed by a single trained interviewer using a structured questionnaire before the laparoscopic examination. The questionnaire included demographic and anthropometric information, occupation, and use of alcohol and tobacco. Regarding dietary habits, subjects were asked how often they consumed 6 food items (fish, meat, rice, vegetable, fruit and dairy products) over the previous year. The frequency of dietary intake was classified into nine categories, i.e., rare, 1–3 times/month, 1–2 times/week, 3–4 times/week, 5–6 times/week, 1 time/day, 2–3 times/day, 4–6 times/day, and more than 7 times/day.