Assessment of dietary intake of non dioxin-like polychlorinated biphenyls in the Italian general population

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Introduction

On the base of some different toxicological properties[1], polychlorinated biphenyls (PCBs) can be divided into two main groups: the dioxin-like PCBs (dl-PCBs), which are the non- and mono-ortho chlorine substituted, and the non-dioxin-like PCBs (ndl-PCBs), which are the multi-ortho chlorine substituted congeners.

The dl-PCBs are 12 congeners with similar toxicological properties to those of the highly toxic compound 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), meanwhile the ndl-PCBs, which are the most abundant in the environment, seem to elicit some different toxicological properties, mainly related to oestrogenicity activity, effects on thyroid and liver and intellectual impairment.

Food, in particular of animal origin, has been recognized by far as the main intake route of PCBs for the general population in Europe[2]. Following this discovery, several investigations in different countries aimed to estimate the dietary exposure to this class of persistent pollutants[3-5], even if paying more attention to the dl- PCBs.

In the present investigation the distribution of the dietary intake of ndl-PCB in the Italian population has been estimated combining data from the national survey[6] of food consumption with average concentration data. The purpose was to derive the average and the high percentiles of the exposure to ndl-PCBs via food in the main groups of age and assess the contribution of the different foodstuff categories to the total intake.

Material and Methods

Food consumption data were provided by the second nation-wide food consumption survey undertaken during 1994-96 by the Istituto Nazionale di Ricerca per gli Alimenti e la Nutrizione (INRAN)[6]. Food intake at individual level was recorded over three to seven consecutive days for 1940 subjects (age 0-94 years) people randomly selected to be representative of the four main Italian geographical areas (North-West, North-East, Centre, South and Islands).

Concentration data were obtained starting from an original unselected database available to the European Commission[7], which contained data submitted by 15 Member States, Iceland and Norway in different proportions. The data set was enlarged, adding data from Italy and France, and examined in detail in order to create a selected database with higher reliability and better suitable for statistical work. The congeners taken into consideration for the exposure assessment were the six canonical indicators of ndl-PCBs (IUPAC number: #28, #52, #101, #138, #153 and #180). Concentration data referred to the following food categories: 1) cereals and cereal products, 2) eggs, 3) fats and oils, 4) fish and fishery products, 5) fruits and vegetables, 6) poultry meat, 7) ruminant meat, 8) pork meat, 9) liver, and 10) milk and dairy products. For categories 1, 4 and 5 data concentrations were expressed as whole product base, so that ndl-PCB intake could be simply calculated multiplying the consumption rate for concentration. For all the other categories, the concentration of PCB was expressed as lipid base. In these cases a food breakdown depending from different fat content and transformation of data concentration from lipid to whole product base was necessary. Fat content was obtained from the Food Composition Tables from INRAN[8]. Once the PCB intake was calculated, data were aggregated again in order to give the intake of ndl-PCB associated to the original ten food categories mentioned above, and summed to give the total intake via food for person. Finally the ndl-PCB intake was divided for the corresponding body weight of each individual.

Statistical analysis of data was carried out with software Statistica 6.1 (StatSoft Italia s.r.l) and SPSS Statistical Software 11.0.

Results and Discussion

Results of PCB intake via food were grouped in three different age ranges: toddlers (0-6), children (7-12) and adults (13-94 years). Since the data distribution for each group revealed to be skewed to the right, data were logarithmic transformed before to calculate the statistical descriptors (Table 1). Results, reverted to linear field, indicated mean values for the $\sum_6$(PCBs) of 24.6, 16.1 and 10.9 ng/kg bw-day for toddlers, children and adults, respectively (Table 1). As expected the intake decreased with age and in particular toddlers have 2-3 times higher PCB intake than adults. This is entirely due to the higher amount of food for body weight unit consumed by toddler in comparison to adults, since the breastfeeding was not considered in the present evaluation.

The PCB intakes estimated in the present evaluation are in the range of results reported in other European Countries[5,9]. In Germany for example, using the method of duplicate meals, the dietary intake of the indicator PCBs for toddlers from 1.5 to 5.3 years has been estimated to be 20.7 ng/kg bw-day (50th percentile) and 69.5 ng/kg bw-day (95th percentiles), values which are very similar to those estimated in this investigation. In comparison to an earlier investigation conducted in Italy in the mid-1990s[8] the present assessment indicate an intake of ndl-PCB ($\sum_6$ (PCBs)) about 30 % lower confirming the decreasing time trend of the dietary intake of these compounds.

The average contribution of the different food groups/subgroups to the total dietary intake, for the three groups of population, is shown in Figure 1. As average the largest contribution is given by milk and dairy products for toddlers (38 %) and by fish and fishery products for children and adults (38 and 42 %, respectively). The high contribution of fish and fishery products to the total dietary intake of PCBs, resulting in the present evaluation, is manly due to the high concentration values for PCBs detected in fish and fishery products rather than to high consumption of these food items.

Table 1. Statistical descriptors of estimated dietary intake of $\sum_6$(ndl PCB) as ng/kg bw-day for three groups of age of Italian population

Population group	N	X_{MIN}	$Q_{.10}$ [a]	X_{MEAN}	SD [b]	$Q_{.90}$	$Q_{.95}$	X_{MAX}
Toddlers (0-6 years) [c]	88	6.35	12.3	24.6	1.72	49.3	60.0	111
Children (7-12 years)	105	4.78	9.01	16.1	1.57	28.7	33.8	46.5
Adults (13-94 years)	1747	2.25	5.90	10.9	1.61	20.0	23.8	50.4

(a) Q, percentile

(b) SD, standard deviation

(c) breastfeeding excluded

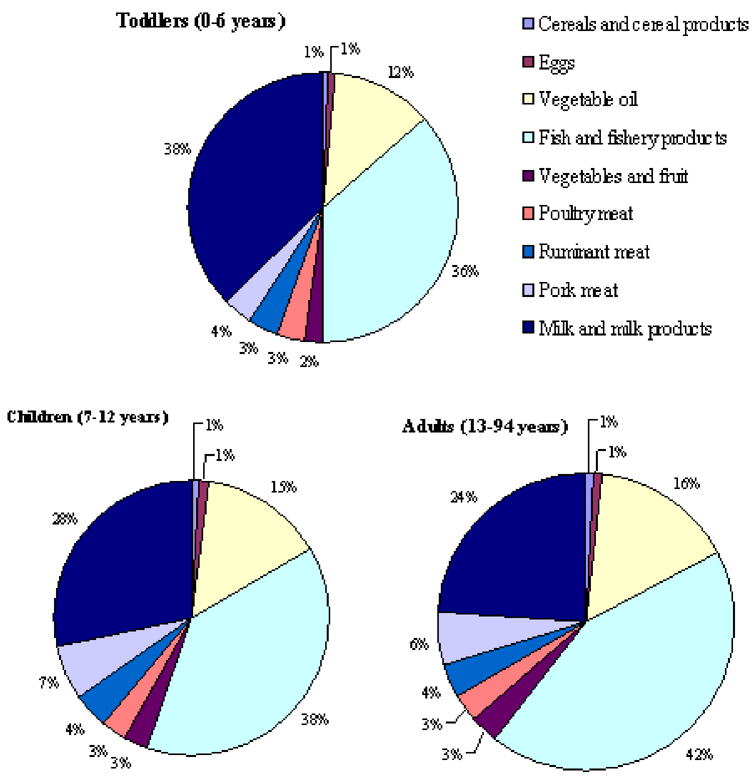

Figure 1. Average contribution of the different food groups/subgroups to the total dietary intake of $\sum_6$(PCBs) estimated for three groups of age in the Italian population. The negligible contributions of “Animal fats”, “Fish oil”, and “Liver” are not shown.

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