TWI FOR DIOXINS AND DL-PCB, CALCULATED WITH 1998 AND 2005 TEFs, PROTECTS AGAINST TOXIC EFFECTS OF NON-DIOXIN LIKE PCB IN NORWEGIAN FOODS

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Introduction

Dietary PCB-exposure involves both dioxin-like PCBs (DL-PCBs) and non-dioxin like-PCBs (NDL-PCBs). The DL-PCBs constitute a small part, approximately 6%, of 36 congeners measured in Norwegian foods. The six indicator PCBs (PCB6), PCB-28, 52, 101, 138, 153 and 180, constitute approximately 50% of all PCBs measured in Norway as well as in the rest of Europe[1,2].

The combined toxic effects of dioxins and DL-PCBs in foods are summarised by use of TCDD-toxic equivalency factors (TEFs). Different TEFs were used until the WHO TEF values were published in 1998[3]. In 2005 the TEF values for dioxins and DL-PCBs were revised, resulting in increased, decreased or unchanged TEF values for individual congeners[3]. An indication of the quantitative impact of the 2005 changes of the TEF values in some selected food samples were also presented[3]. In general, the changes in 2005 values had limited impact on the total TEQ in the samples, with an overall decrease in TEQ between 10 and 25%. In selected Norwegian foods, the decrease was 5 to 45%[4].

For the dioxins and DL-PCBs, the tolerable weekly intake (TWI) at 14 pg TEQ/kg body weight was set by the Scientific Committee on Food (SCF) in 2001[5]. For the NDL-PCBs, there is no tolerable intake established by international bodies working with risk assessment of contaminants. In the EFSA opinion on NDL-PCBs published in 2005[2], the Panel noted that "*the comprehensive toxicological database on health effects of technical PCB mixtures was not suitable for the separate assessment of NDL-PCB, and that the human data on exposure to environmental mixtures containing PCB could not differentiate between the effects of NDL-PCB and DL-PCB and polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans.*"

Based on human studies involving perinatal exposure, benchmark dose calculations (5% incidence in neurological and immune effects in children) indicate a 95% lower confidence limit (BMDL) of approximately 1 µg PCB/g lipid in the body of the mother[2]. If the toxicokinetic model of the EFSA opinion is used[2], a daily intake of 40 ng PCBs/kg body weight/day would result in a serum level of 1 µg PCB/g lipid. Since effects of DL-PCBs could not be differentiated from those of NDL-PCBs, these studies were excluded as a basis for the evaluation of NDL-PCBs in EFSA's opinion on NDL-PCBs[2].

The aim of the present study was to **a)** calculate the size of the expected reduction in calculated TEQ exposure with the 2005 TEF values, and **b)** to evaluate whether the TWI set for dioxins and DL-PCBs also protects against toxic effects that may arise after dietary exposure to NDL-PCBs.

The Panel on Contaminants of the Norwegian Scientific Committee for Food Safety (VKM) recently conducted a risk assessment of non NDL-PCBs in Norwegian food[1]. The present abstract is based on a part of the VKM risk assessment, which has been reinforced by the addition of a calculation of a possible impact of the 2005 WHO TEFs for dioxins and DL-PCBs.

Materials and Methods

The study group (n=193) participated in the Norwegian Fish- and Game study, part C, which is an in-depth study of a selection of participants in a larger study (5002 participants). Two-thirds of the participants were invited due to their regular consumption of foods with potentially high back-ground levels of PCBs, dioxins, mercury or cadmium. The last third was drawn randomly. Nine of the participants were excluded due to unlikely energy intakes (less than 1000 and more than 4000 kcal/day), leaving 184 participants for final dietary exposure analysis. The Norwegian Fish- and Game study, part C, is not country representative, but shows the possible range of dietary contaminant exposure among Norwegians living in non-contaminated areas[6,7].

Dietary exposure was assessed using a 12-page semi-quantitative food frequency questionnaire (FFQ) covering the last year. Food frequencies were converted into consumption (grams/day) using standard gender-specific portion sizes. Exposure was calculated using a database comprising available levels of dioxins and PCBs in Norwegian foods from the period 2000 to 2006.

Results and Discussion

The mean calculated dietary exposure to dioxins and DL-PCBs in the Norwegian Fish and Game Study, part C, was reduced by 16% when calculated with 2005 TEFs instead of 1998 TEFs (figure 1A). The contribution from dioxins was practically unchanged, whereas the contribution from non-*ortho* PCBs to total TEQ increased from 52% calculated with 1998 TEFs to 65% calculated with 2005 TEFs. This increase was outweighed by a reduction from 18% to 5% in sum TEQ coming from mono-*ortho* PCBs (figure 1B).

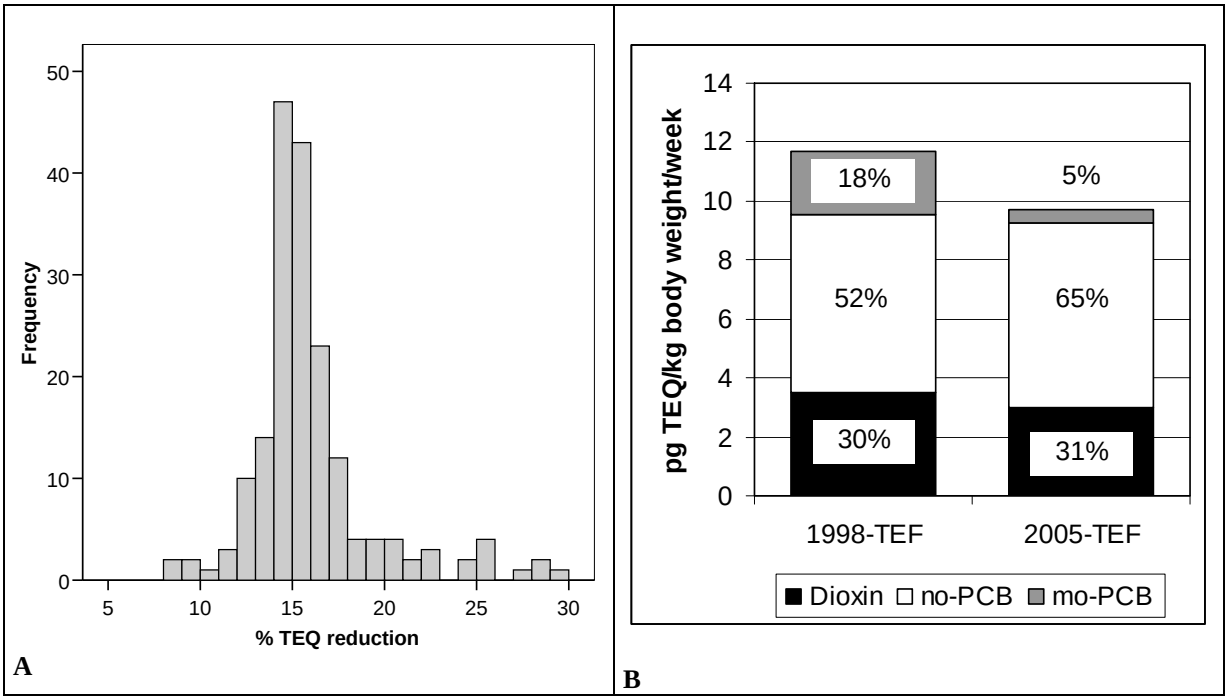

Figure 1: *Effects of the 2005-TEFs on mean calculated dietary exposure to dioxins and DL-PCBs in the Norwegian fish and Game study, part C.* **A:** % TEQ reduction with 2005 TEFs compared with 1998 TEFs. **B:** Contribution from dioxins, mono-*ortho* PCBs and non-*ortho* PCBs to total TEQ intake.

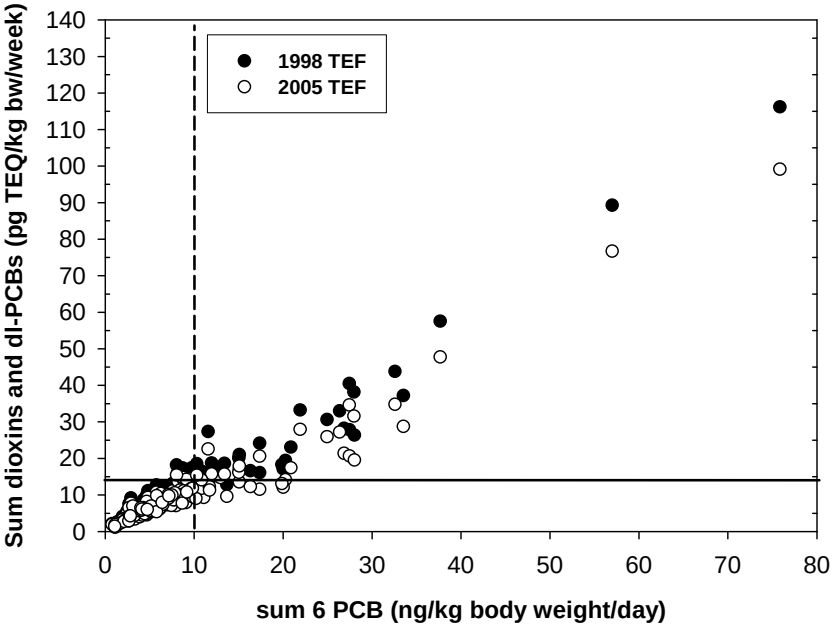

Figure 2: *Dietary intake of PCB6 versus dietary intake of dioxins and DL-PCBs in the Norwegian Fish & Game study, part C, calculated with 1998 TEFs and 2005 TEFs.* Horizontal solid line: TWI for dioxins and DL-PCBs (14 pg TEQ/kg body weight/week). Vertical dotted line: reference value for PCB6 (10 ng PCB6/ kg body weight per day).

Recently, the French Food Safety Agency (Afssa) adopted a TDI of 10 ng PCB6/day, derived from neurological effects observed in monkeys and that PCB6 account for almost 50% of all PCB congeners present[8]. A serum level of 1 µg PCB/g lipid, the BMDL for total PCB exposure identified by EFSA[2], will result from a daily intake of 40 ng PCBs/kg body weight. Assuming that the 6 indicator NDL-PCBs constitute about 50% of the BMDL value, this would correspond to 0.5 µg PCB6/g lipid, and an intake of about 20 ng PCB6/kg body weight per day. Panel 5 in VKM decided to use half of this value, 10 ng PCB6/kg body weight per day, as a reference value in evaluation of the protective effect of the TWI for dioxins and DL-PCBs on NDL-PCBs in the diet of Norwegians[1].

The calculated dietary intake of PCB6 versus the calculated dietary intake of dioxins and DL-PCBs among participants in the Norwegian Fish- and Game Study is shown in Figure 2. A very good correlation between exposure to dioxins and DL-PCBs and PCB6 from the Norwegian diet was found. Furthermore, the majority of the participants who had a calculated intake of dioxins and DL-PCBs below the TWI for dioxins and DL-PCBs (solid horizontal line in figure 2) also had a calculated daily intake of PCB6 that was below the reference value for PCB6 (dotted vertical line in figure 2). Only a few of the participants had a dietary intake that exceeded the reference value for PCB6, but were still below EU's TWI for dioxins and DL-PCBs. However, the excursions for those participants were marginal. When dietary intake was calculated with 2005 TEFs (open circles), a slightly higher proportion of the participants had dietary exposure which was below the TWI for dioxins and DL-PCBs, but above the reference value for PCB6. However, the excursions were still marginal and below the 20 ng PCB6/kg body weight/day derived from the BMDL for perinatal PCB exposure in humans.

Conclusions

The TWI at 14 pg TEQ/kg body weight/week for dioxins and DL-PCBs will generally also protect against adverse effects that may arise from dietary exposure to total PCB including NDL-PCBs given the present composition and levels of dioxins, DL-PCBs and NDL-PCBs in Norwegian foods.

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