PCB-BLOOD LEVELS IN TEACHERS, WORKING IN PCB-CONTAMINATED SCHOOLS.

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Introduction

Indoor air contamination of school buildings with PCBs is a considerable problem in Germany. Many concrete school buildings, that were constructed between 1960 and 1980, contain elastic sealant material with high portions of technical mixtures of PCBs(1, 2). Continuous PCB-emission from these sources leads to secondary contamination of floors, walls and ceilings and causes a steadily increasing indoor air contamination. Typical PCB-concentrations range between 500 and 10000 ng/m^3.

Detection of PCB-contamination in schools is usually accompanied with considerable public concern about potential health hazards to children and teachers, even at levels which are far below the recommended intervention limit of 9000 ng/m^3. This is often followed by very costly evacuation of classes and subsequent decontamination and remediation.

In the present study teachers from three PCB-contaminated schools with maximum PCB levels ranging from 1587 to 10655 ng/m^3 and two control schools were analyzed for blood PCB-levels and inquired for confounders. The aim of the study was to get more information on the effect of PCBs in indoor air on the pattern and concentration of PCB in blood.

Material and Methods

Three schools with PCB indoor air contamination (school 1, school 2, school 3) and two control school were investigated from November 1994 to April 1995. Blood from 151 teachers, 96 from contaminated schools (24, 35 and 37 teachers) and 55 from the control schools, was analyzed. The distribution of age and sex was almost equal in all groups. The mean age of each group ranged between 47 - 52 years. The teachers participated on a voluntary basis. Written informed consent was obtained.

PCB indoor air was measured by free analytic institutes. Ten ml of full blood were taken by the local health authorities with a contamination free syringe, transferred into a glass tube and frozen at –80 C° until analysis.

100 µl of internal standard was added to 10 ml thawn blood. The blood was extracted 3 times with 10 ml petrolether/aceton (1:1). The extract was evaporated to 100 µl. The residue was dissolved in 5 ml petrolether/aceton (8:1) and cleaned on a Florisil column (diameter: 1 cm, hight: 20 cm). The column was prefilled with 15 ml acetone, 0,5 g Na_2SO_4, 1 g Florisil, 0,5g Na_2SO_4. The column was eluted 4 x 5 ml acetone. The combined eluate was reduced to 100 µl by evaporation in a N_2 -stream. The residue was dissolved in 100 µl n-octane and analyzed by GC-ECD. PCB 28, 101, 138, 153, and 180 could be detected with a detection limit of 0,02 µg/l blood, PCB 52 could not be detected due to matrix effects.

Results

In school 1 four rooms were measured with PCB concentrations ranging from 181 to 1587 ng/m³ , the mean value was 635 ng/m³. In school 2 five rooms were measured with a PCB concentrations ranging from 3060 to 10655 ng/m³, the mean value was 7749 ng/m³. In school 3 nine rooms were measured with PCB concentrations ranging from 77 to 10125 ng/m³ , the mean value was 3541 ng/m³.

Each of the three schools had a characteristic PCB pattern (figure 1).
In school 1 and 2 the low chlorinated PCB 28 and 52 prevailed and contributed almost 90 % to the sum of the 6 indicator congeners. In school 3 the medium chlorinated PCB dominated.

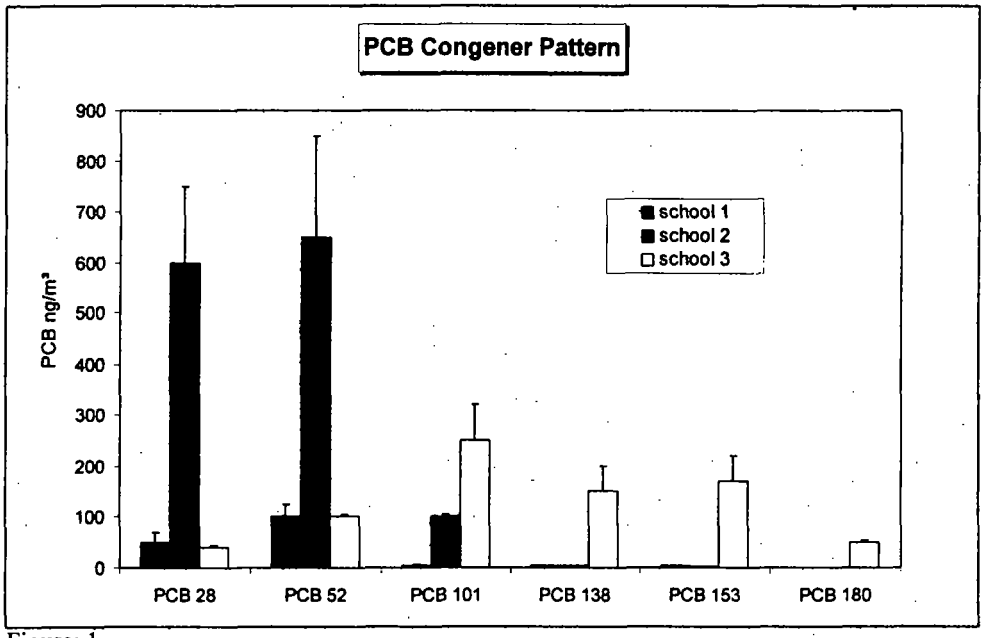

Figure: 1

The blood concentrations of PCB 138, 153 and 180 were similar for the four groups of teachers and within the range of the usual background level (figure 2). However there appeared to be differences with regard to PCB 28 and 101. In school 1, 2 and 3 the mean PCB

28 concentration in blood was 0.045, 0.098, and 0.057 µg/l respectively, for the control group the concentration was 0.035 µg/l and very close to the detection limit. Thus the value in school 2 significantly exceeded the concentrations in the other groups ($p < 0.001$).

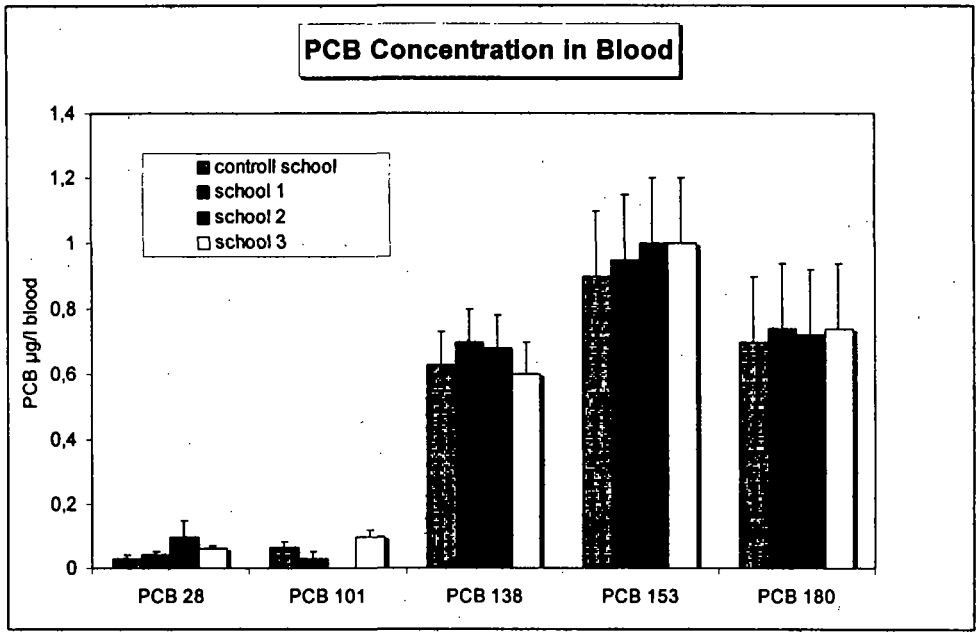

Figure 2

Discussion

The prevailing background concentration of PCBs in human blood (control group) is mainly caused by uptake with food. Out of the 6 indicator congeners, only PCB 138, 153, and 180 can be routinely detected in human blood. In contrast the concentrations of PCB 28, 52 and 101 are much lower and usually below the detection limit, mainly due to the faster enzymatic degradation of PCBs with low chlorination in animals (food source) and humans (3).

The present investigation studied schools with indoor contamination with PCBs of low and intermediate chlorination respectively. Despite high indoor air concentration (sum of six indicator congeners) no significant increase in blood levels could be detected for PCB 138, 153 and 180 in exposed teachers compared to the control group. However, there appeared to be a distinct effect on PCB 28 and a slight effect on PCB 101. In other words, the high indoor air concentration with PCB 28 in school 2 was associated with a significant increase in mean blood concentration from 0.035 µl/l (control group) to 0.098 µg/l. It can be calculated that this rise by 0.063 µg/l PCB 28 increased the total PCB blood level by 2.8% (sum of the 6 indicator congeners 2,2 µg/l). Considering that PCB 28 contributed 45% of the indicator congeners in indoor air, the total increase of PCB blood concentration for exposed individuals can be estimated to be approximately 6 %.

On the basis of the present results and observation of other authors, the following conclusions are made for indoor air contamination with PCB exhibiting low and medium chlorination pattern: PCB indoor concentrations below 1000 ng/m³ have no observable effect to the PCB blood level of exposed teachers (mean residue time about 4 hours per day). Even at indoor PCB levels up to 10000 ng/m³ the increase of PCB concentration in blood is small compared to the mean PCB blood concentration caused by food intake. Further studies will have to reveal the situation, if residence time is longer or if PCB with higher chlorination prevail in indoor air.

References

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