Occupational Exposure to PCDD/PCDF and Emotional Complaints and Deficits

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1. Introduction

In a cross sectional study the issue was examined, whether occupational exposure to PCDD/PCDF, as it was determined in chemical workers, leads to depressive symptoms and other emotional deficits.

The literature review revealed discussion of effects on the central nervous system. So far only few systematic investigations of this problem are available. Most studies report on case reports or follow-up-studies.
Schulz and Spiegelberg were the first to show, that Chlorakne was connected with exposure to Tetrachlorodibenzodioxin (TCDD) [2].
Other case reports and follow-up-studies reported on the following complaints: loss of libido, difficulities to concentrate and to remember, lack of impulse, lability of affect, emotional restlessness and aggressiveness, depressive symptoms, suicidal ideas and suicidal attempts [3],[7],[9],[10],[11],[12].
Elevated rates of suicide in persons exposed to PCDD/PCDF were observed in three mortality studies [5],[8],[14]. In another mortality study excess of deaths due to suicide were found but the increase was not statistically significant [4].
Three cross-sectional studies using test batteries in order to evaluate central nervous system problems did not reveal differences regarding the tests between exposed and unexposed groups [1],[6],[13].

Eventhough tension/anxiety and anger /hostility (subscales of the profile of mood status (POMS) - Test) were more often found in the exposed group of a study [6]) and loss of libido was more often reported in the exposed group of another study [13]).

2. Materials and Methods

The study comprised 107 male workers, formerly employed in a German chemical plant, producing insecticides and herbicides. A battery of psychological tests, as well as a questionnaire containing lifetime medical and occupational history and lifestyle information (smoking habits, drinking habits) and specific emotional complaints was administered to all participants by one medical doctor. The list of emotional complaints was compiled by reviewing the literature.
The test battery included the
- Freiburger Personality inventory (FPI)
- Hamilton Depression Scale (HDS)
- Beck Depression Inventory (BDI)
- V.Zerssen Depression Scale (DS and D'S)
- BENTON-Test
- D2-Attention-Stress-Test (D2-Test)
- Cerebral Insufficiency Test (C.I. Test)

PCDD/PCDF exposure status was measured by TEQ blood-fat values (UBA, BGA). The interviewer was blind regarding the exposure status of all participants.
Chi-square-tests were applied in order to detect differences between exposure groups ($p \leq 0.15$ was used as significant level for the explorative tests). If differences between the groups were found, logistic regession were used in order to calculate adjusted odds ratios and 95 % confidence intervalls. Potential confounders were age, alcohol, smoking, life events, education, and diseases. Statistically important variables ($p < 0.1$) were kept in the model. The analysis was run with the windows version of SPSS 5.0.

3. Results

The minimal internal exposure was found to be 2 ng/kg blood-fat, the maximal internal exposure reached 2451 ng/kg blood-fat, and the median amounted to 270 ng/kg blood-fat.
The dichotomized exposure groups (low and high exposed), using the median as boundary, were further evaluated.

One of the three depression tests, the Hamilton Depression Scale, showed a statistically significant higher prevalence of depressive symptoms for the high-exposive group (14% of the low-exposive and 37% of the high-exposive group). The two other depression tests showed no statistically significant differences, but a slightly higher prevalence of depressive symptoms for the high-exposive group (*see table 1)*.

Table 1: *Depression Tests*

		TEQ low ≤ 270ng/kg		TEQ high > 270ng/kg	
		count	%	count	%
Hamilton:	**depressive**	7	13.5	19	36.5
Beck:	**depressive**	25	49.0	29	61.7
v.Zerssen:	**depressive**	36	69.2	42	80.8

There were no statistically significant differences for any of the three applied concentration tests. No statistically significant difference was found for the variables of the Freiburger Personality Inventory. *Feelings of sadness, feelings of anxiety, excitability and aggressiveness, emotional uneasiness and irritability, suicidal thoughts,* as well as *libido and sexual dysfunction* were mentioned more often ($p \leq 0.15$) by the high-exposive group than by the low-exposive group. The most distinct differences were found for *excitability and aggressiveness* (60% of the low-exposive group versus 85% of the high-exposive group) and for *suicidal thoughts* (39% of the low-exposive group versus 64% of the high-exposive group).

In the multivariate Analysis the following confounders were taken into account for modelling: age, alcohol, smoking, lifeevents and gastrointestinal diseases.

For findings with the Hamilton Depression Scale an adjusted OR of 2.96, which was statistically significant, was found. Statistically significant elevated OR's were also found for *excitability and aggressiveness* (OR 3.28, 95% CI 1.26-8.56), *emotional uneasiness and irritability* (OR 2.6, 95% 1.02-6.62), and for *suicidal thoughts* (OR 2.78, 95% 1.26-6.15) *(see table 2)*.

Table 2: *Crude and adjusted estimates*

	crude		adjusted	
	OR	**95 % CI**	**OR**	**95 % CI**
Hamilton Depression Scale	3.70	(1.39 - 9.82)	2.96	(1.07 - 8.24)
feelings of sadness	1.93	(0.86 - 4.30)	1.76	(0.77 - 4.01)
feelings of anxiety	1.88	(0.86 - 4.11)	1.80	(0.77 - 4.20)
excitabilty and aggression	3.72	(1.46 - 9.49)	3.28	(1.26 - 8.56)
emotional uneasiness and irritability	2.99	(1.20 - 7.42)	2.60	(1.02 - 6.62)
suicidal thoughts	2.78	(1.26 - 6.15)	*	
libido and sexual dysfunction	1.91	(0.86 - 4.22)	1.80	(0.79 - 4.12)

* no variable met the model criterium, no model calculated

4. Conclusions

It is unlikely, that the observed results are caused by confounding, because we were able to control for the most important confounders, eventhough residual confounding cannot be completely ruled out.
The response rate for both groups was about 50%. Therefore selection bias is an unlikely explanation for our findings. An observer bias can be also ruled out, because the physician who did all tests and interviews was blind regarding the exposure status of the participants.
We are even inclined to believe, that we were underestimating effects, because our control-group was not free of exposure to PCDD/PCDF.
Nondifferential exposure missclassification is also very likely. This should have introduced a bias towards the null value.

In conclusion, the data of this study yield support for the hypothesis, that exposure to PCDD/PCDF, as it was observed for former Chemical workers of the German chemical production plant Boehringer, can lead to depressive symptoms and to other emotional complaints and deficits.

5. References

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