

Pesticide Exposure as Independent Predictor of Neurological Functioning and Blood Pressure in Ecuadorian school children.

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Background

- The developing nervous system is particularly vulnerable to environmental toxicants due to its immaturity to protect itself and the activation several biological processes (1). There are a few epidemiological studies reporting children with prenatal and current exposure to pesticides, particularly organophosphates, and neurodevelopment. These studies have concluded that early exposure to pesticides may alter several neurobehavioral areas such as visual-performance and motor skills, even though years after the exposure (2,3).

Children in the floriculture districts of Ecuador may be exposed to pesticides, with prenatal exposures occurring if the mother worked in a greenhouse during pregnancy.



Objectives

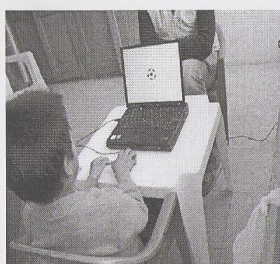
- To assess neurobehavioral function in school-age children and its association with prenatal pesticide exposure from maternal work during pregnancy, while taking into account current exposure and other risk factors.

Methods

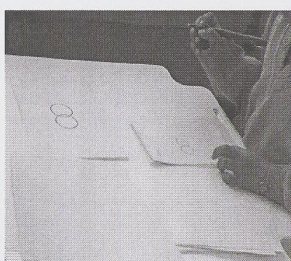
- We invited all pupils attending the first two grades of the local school (two 9-years-olds were excluded.) The tests included physical examination, audiometry, neurophysiology (delayed brainstem evoked potential latencies and heart rate variability) and neuropsychological examination aimed at functions that are likely to be sensitive to developmental pesticide exposure (2,4,5). The maternal interview and exposure status assessment was blinded in regard to the outcome data. Current pesticide exposure was assessed by urinary excretion of organophosphate metabolites.



First grade at Tabacundo school



Continuous Performance Task



Stanford-Binet Copying Test

References

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Results

- Ninety six % of the eligible children participated in the study, of whom 35 children were considered prenatally exposed to pesticides because of direct maternal exposure and 23 indirectly through paternal exposure. Twenty-two children showed detectable urinary metabolites suggesting current exposure.
- There was no association between prenatal and current exposures (Table 1).

Table 1. Number of Cases with Detectable Levels of Current Pesticide Exposure for 81 Ecuadorian Primary School Children Without (Controls) and With (Exposed) Prenatal Pesticide Exposure from Maternal Occupational Exposure.

Analyte (yes / no)	Controls (n=46)	Exposed (n=35)	P
Dimethyldithiophosphates	-	-	-
Dimethylthiophosphates	7 / 39	8 / 27	0.40
Dimethylphosphates	4 / 42	3 / 32	0.98
Diethylthiophosphates	3 / 43	1 / 34	0.45
Diethyldithiophosphates	-	-	-
Diethylphosphates	4 / 42	2 / 32	0.61
All dimethyl metabolites	8 / 38	9 / 26	0.39
All diethyl metabolites	5 / 41	3 / 32	0.73
All metabolites	12 / 34	10 / 25	0.80

P-value for χ^2 tests of differences of percentages. Results were similar when paternal exposure during pregnancy (n=23) was treated as a separate category from control group.

- Multivariate models showed significant negative associations between neuropsychological performance scorings and prenatal exposure to pesticides (Table 2).
- Motor speed, visual memory and performance were the most strongly affected functions.
- Currently exposed children only showed a marginally significant higher level of perseverations on Continuous Performance.
- Among other health outcomes studied, only systolic blood pressure (beta (SD) = 4.5 (2.2)) was positively associated with prenatal pesticide exposure.

Table 2. Multivariate regression results† for prenatal and current exposures to pesticides and neuropsychological outcomes

Outcome Scores (n)	Prenatal Exposure		Current Exposure		
	No ^R (26)	Father, Yes (23)	Mother, Yes (35)	No ^R (59)	Yes (22)
Simple Motor Speed (Finger Taping)					
Mean of num. of taps, both hands, β (SD)	31.0 (8.0)	-2.7 (2.5)	-4.7 (2.3)**	29.5 (8.2)	-2.9 (2.0)
Attention Skills (Continuous Performance Task)					
Number of Omissions, β (SD)	19 (11)	-2 (4)	-3 (3)	16 (11)	4 (3)
Number of Commissions, OR (CI) ‡	1.00	2.08 (0.28-15.30)	3.17 (0.50-19.94)	1.00	1.26 (0.28-5.62)
Number of Perseverations, OR (CI) ‡	1.00	1.76 (0.32-9.57)	0.59 (0.12-2.74)	1.00	3.13* (0.84-11.69)
Memory Skills (WISC-Revise d)					
Memory Digits, β (SD)	2.6 (1.20)	-0.4 (0.4)	-0.6 (0.3)*	2.1 (1.2)	-0.3 (0.3)
Memory Digit Strings, β (SD)	4.9 (0.7)	-0.1 (0.2)	-0.4 (0.2)*	4.6 (0.8)	-0.1 (0.2)
Visual-Performance Abilities (Stanford-Binet Copying Test)					
Errors in copying (Designs 13-20), β (SD) §	1.0 (0.7)	0.3 (0.2)	0.5 (0.2)**	1.3 (0.8)	0.1 (0.2)
Total Errors in copying, OR (CI) ‡	1.00	2.93 (0.53-16.03)	1.40 (0.29-6.85)	1.00	1.60 (0.42-6.03)
Visual Memory (Stanford-Binet Recall Test)					
Number of Correct Recalls, OR (CI) ‡	1.00	7.30* (0.96-55.43)	6.97** (1.08-45.10)	1.00	0.81 (0.21-3.17)

† Each line are two multivariate models (linear or logistic regressions) controlled for: child's sex, age, race, number of daily meals, ponderal index, stunting, school grade and having repeated one course, maternal education level, civil status, parity and delivery at home, family living in a traditional house, drinking water supply and sewage drainage at home, paternal education and being employed. When current exposure was treated as continuous variable (log [microg/kg per day]), the results were unchanged (data not shown).

‡ Santa Ana Form Board (motor coordination), Continuous Performance Task (Reaction Time), Raven Test (Visual-Performance Abilities) and WISC-R (Memory Sentences) are not shown in the Table. All of them didn't show significant associations with current and prenatal exposures (data not shown).

Re: Not exposed group, Mean (SD) or OR=1.

§ No normal distributed outcome. Logistic regression models were used. The intercept is the median. Reference group: children with better scores.

‡ Outcome transformed to accomplish normal distribution.

* Associations showing a p-value<0.10; ** p-value<0.05

Conclusion

- Young school children with prenatal pesticide exposure from maternal employment in floriculture are at increased risk to show functional deficits in several neuropsychological domains and higher levels of blood pressure.
- These results are in close agreement with a previous pilot study that suggested visuospatial deficits and increased blood pressure (2), additionally to motor abilities showed in others studies (3). Thus, although women exposed to pesticides at work may not suffer any important adverse health effects, brain development in their children may be adversely affected if exposed during pregnancy.



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