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ABSTRACT

A study was undertaken to determine the effects of tobacco smoke in the home on children's cognitive development. The study focused on 280 children, representing equal numbers of boys and girls and of Whites, Blacks, and Hispanics. When the participating children were 2 years old, their mothers were surveyed, interviewed, and tested to gather information on socioeconomic status, smoking habits, day care, infant feeding practices, intelligence, and the home environment. At age 3, the children completed the Stanford-Binet Fourth Edition (SBIV) measure of intelligence quotient (IQ) and the Peabody Picture Vocabulary Test. Data analysis revealed that the total number of packs of cigarettes smoked in the home was inversely related to child intelligence. Specifically, data indicated that as cigarette smoking increased by 1 pack per day, child IQ decreased by 1.65 points. Further analysis found that only the amount smoked by the mother was related to the children's IQ scores. Finally, data were also analyzed for 108 of the original children retested at 5 years of age, revealing that the particular relation of mothers' smoking habits to child IQ at 5 was not statistically significant. Study findings support the growing body of evidence that inhaling tobacco smoke from the environment has harmful effects on development. (AC)

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# Tobacco Smoke in the Home and Child Intelligence

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## Abstract

In a sample of 280 3-year-old children, smoking in the home was found to contribute significantly and inversely to intelligence. Children of normal birthweight and without neurological impairment had been enrolled in a longitudinal study. Analyses were conducted with gender, ethnicity, SES HOME, day care, and mother intelligence controlled. Significant results were obtained for the Peabody Picture Vocabulary Test Revised (PPVT-R) and all Stanford-Binet Fourth Edition (SBIV) scales except Bead Memory. With a sample of 108 of the children at age 5 smoking was found to have an effect on SBIV Reasoning/Visualization. All effects were for mother, not father, smoking in the home.



The effects of tobacco smoke on smokers are now well-established and the consequences for children of mothers smoking during pregnancy are well-known (Streissguth, 1986). There is increased interest in the effects of incidental smoke on others in the environment. There is suggestive evidence that living in a tobacco smoke environment increases the risk of such illnesses as cancer, lower respiratory infections, asthma, and behavior problems, but effects on cognitive development in children have received little attention. The present study examined the relationship of amount of tobacco smoke in the home to the intelligence of three-year-old children.

## Method

### Subjects

There were 280 children in a longitudinal study of child development. They included an approximately equal number of girls and boys and were also approximately equal in ethnic representation with Anglo, Black and Hispanic children included. The social class distribution was broad. Children were enrolled in the project at birth. Low birth weight (under 2.5 kg.) and neurologically impaired infants were excluded.

Procedure

When the children were two years of age, mothers completed information for the Hollingshead Four-Factor Index of Socioeconomic Status (Hollingshead, 1976), responded to an interview on smoking, day care, infant feeding practices, and other home events or practices, took the Shipley test of intelligence and took part in the Home Observation of the Measured Environment (HOME) (Caldwell & Bradley, 1984). These measures were completed to provide information for environmental influences on intelligence. At age three, the children were tested with the Stanford-Binet Fourth Edition (SBIV) and Peabody Picture Vocabulary Test-Revised (PPVT-R) by three female psychology graduate students.

Results

A first analysis found that the total number of packs of cigarettes smoked in the home was inversely related to the child's intelligence at age three. SES, ethnicity, gender, mother's intelligence, and amount of time spent in day care during the three years were controlled for statistically using the SAS GLM procedure. Results of these analyses indicated that cigarette smoke was significantly and inversely related to the SBIV Composite ($F(1,278) = 5.18$; $p < .05$, Reasoning/Visualization Factor ($F(1,277) = 4.01$; $p < .05$), Copying ($F(1,258) = 5.77$; $p < .05$), Quantitative ($F(1,207) = 4.74$: $p < .05$), and Vocabulary ($F(1,276) = 5.97$; $p < .05$). Simple correlations with the environmental factors controlled were significant for all SBIV scales except Bead Memory. Correlations ranged from .17 to .21. When extraneous variables are controlled, the smoking variable adds slightly more than one percent to the predictable variance in intelligence.

PPVT-R scores were also related significantly to the mother's smoking ($t(259) = -1.87$; $p < .05$).

To better understand the relation of cigarette smoking to intelligence, consider that for the SBIV Composite score, the regression coefficient for cigarette smoking was -1.65. This means that as cigarette smoking goes up by one pack, the child's IQ is 1.65 points less. This would appear to be a relatively small, but statistically reliable effect. A 3-year-old in a home where two adults smoke a pack of cigarettes each per day would be expected to have an IQ more than 3 points lower than the child in a comparable home where no cigarettes were smoked. When considering the whole range of smoking from zero to 7.5 packs per day (the maximum reported), we would predict more than a 12 point IQ difference between the child in a smokeless home and the one that had 7.5 packs per day.

As the cigarette smoking distribution was highly skewed, a second series of analyses was conducted using log transformation of the number of packs smoked per household.

The only difference in outcome was that the Reasoning/Verbalization Factor narrowly failed to reach significance.

In a third analysis, the same variables were considered except that smoking was broken out into three components: the amount the mother smoked, the amount the father smoked, and the amount others in the home smoked. The results indicated that it was the amount smoked by the mother that was related to the intelligence scores. For the SBIV Composite score, mother's smoking contributed significantly ($t(267) = -2.50$; $p < .01$). The weight parameter for mother's smoking was -3.5 meaning that there was evidence of a 3-point decline in intelligence per pack of cigarettes smoked by the mother. Similar results were found for the Verbal Area score ($t(267) = -2.14$; $p < .05$), Verbal/Comprehension Factor ($t(267) = -1.83$; $p < .05$), Quantitative ($t(267) = -1.68$; $p < .05$), and Reasoning/Visualization Factor ($t(267) = -2.15$; $p < .01$).

When a similar analysis was done for the data on children at five years of age, the relation of mother's smoking to child intelligence was not statistically significant, but the parameter estimate was actually larger than for the results on three-year-olds (-3.81). However, this failed to reach significance owing to the smaller number of subjects tested so far at age five (108) compared with the number included at age 3 (280). There was one result with five-year-olds in that the Visualization/Reasoning Factor was significantly related to the amount mother smoked ($t(94) = -1.83$; $p < .05$). The parameter estimate would indicate that mothers who smoked a pack of cigarettes a day would be predicted to have five year olds with IQs 5.5 points lower.

## Discussion

These results add support to the growing body of evidence that inhaling tobacco smoke from the environment has harmful effects on development. The results do not indicate how this comes about; one possibility is that attentional processes in the child are impaired by tobacco by-products and this, in turn, affects the development of intelligence. An attentional mediator would be in accord with the finding by Weitzman, Gortmaker and Sobel (1992) that maternal smoking during pregnancy and during the child's infancy were independently associated with increased levels of behavior problems. However, there are a number of other possible mechanisms through which cognitive development might be affected

Our results must be regarded as preliminary. There are a number of remaining problems. One is that we do not know whether the mothers smoked during pregnancy. The most commonly observed infant outcome related to maternal

smoking, low birth weight, was controlled by excluding infants weighing less than 2.5 kgs., and we may have thus controlled for some of the effects of smoking during pregnancy. The findings of Weitzman, Gortmaker and Sobol (1992) of independent effects of smoking during pregnancy or after suggest that we may have a similar result. However, we did not ask about smoking during pregnancy. We are attempting to collect that information now.

There are other related problems. Mothers who smoke are more likely to be depressed, anxious or have other mental health problems (Haines, Imeson & Meade, 1980). In addition, it may be that smoking is associated with substance abuse and other problems suggesting a parental life-style that is not optimal for child development. Streissguth, Barr, Sampson, Darby and Martin (1989) found not effects on child intelligence when alcohol drinking was controlled). Although life-style factors may account for the results, it should be recalled that HOME was used to assess the quality of educational stimulation in the home, and this factor was controlled in the analyses. That control does not apply to the direct effect on child intelligence of maternal drinking during pregnancy and it is possible that mothers in our study drank during pregnancy. We are collecting data on that matter now.

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