DDT and PBDE exposure and obesity in CHAMACOS women

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Introduction
The increasing prevalence of obesity is a major public health concern.[1] Environmental exposure to endocrine-disrupting chemicals, including dichlorodiphenyltrichloroethane (DDT), dichlorodiphenyldichloroethylene (DDE), and polybrominated diphenyl ether (PBDE) flame retardants, has been hypothesized to increase risk of obesity.[2-4]

The Center for the Health Assessment of Mothers and Children of Salinas (CHAMACOS), initiated in 1998, is a well-established longitudinal birth cohort of ~600 low-income, Mexican American mother-child dyads living in Salinas Valley, California, an agricultural community.[5] At enrollment, CHAMACOS mothers were primarily young, married, low income, Mexican-born, and Spanish-speaking. Many were farmworkers themselves or lived with farmworkers. CHAMACOS mothers, by virtue of emigrating from Mexico to California, have been uniquely exposed to persistent endocrine-disrupting chemicals that may impact their health. Specifically, we have demonstrated exposure to DDT, which was used in Mexico until the year 2000, and its primary breakdown product DDE, as well as to PBDE flame retardants, which have historically high use in consumer products in California given the state’s strict flammability standards.[6-8] Although we have previously examined the relationship of these chemical exposures with obesity in the children [9-12], we have not yet investigated their effects in the mothers, a group at high risk for obesity.[13] Using data from the CHAMACOS study, we examined the longitudinal relationship of serum DDT/E and PBDE concentrations with obesity among CHAMACOS mothers.

Materials and methods
CHAMACOS mothers underwent a fasting blood draw as part of the study visit when cohort children were 9 years old (2009-2011) and serum concentrations of \( p,p' \)-DDT, \( p,p' \)-DDE, and several PBDE congeners including BDE-47, BDE-99, BDE-100, and BDE-153, were measured by gas chromatography isotope dilution high-resolution mass spectrometry (GC-IDHRMS) [14] for 467 women. Anthropometry measurements and personal interviews were completed for mothers as part of the study visits when cohort children were 9-, 10.5-, and 12-years old, at which time body mass index (BMI, kg/m²) and categorical BMI (underweight <18.5 kg/m², normal 18.5-24.9 kg/m², overweight, 25.0-29.9 kg/m²; obese, ≥30.0 kg/m²) were calculated.[15] Generalized estimation equations (GEE) were used to evaluate longitudinal associations between DDT/E and PBDE exposure and BMI and obesity from 2009-2014.

Results and discussion
The 467 women were an average age at blood draw of 36.5(±5.5) years. The average BMI of women at the 12-year visit was 31.5 (±6.3) kg/m², and 54.2% of women were obese. In GEE models, log10-transformed DDT was significantly positively associated with BMI (adjusted-\( \beta \)= 1.71, 95% CI 0.61, 2.82) and risk of obesity (adjusted-
For PBDEs, log₁₀-transformed BDE-47 was significantly positively associated with BMI (adjusted-β = 2.13, 95% CI 0.67, 3.58) and risk of obesity (adjusted-RR = 1.39, 95% CI 1.13, 1.72). In contrast, log₁₀-transformed BDE-153 was inversely associated with BMI (adjusted-β = -2.79, 95% CI -4.78, -0.81) and risk of obesity (adjusted-RR = 0.75, 95% CI 0.56, 0.99).

These results provide support for the chemical obesogen hypothesis, that exposure to endocrine-disrupting chemicals may alter risk of obesity, in this case an increased risk of obesity in women exposed to DDT and PBDE-47, but decreased risk with PBDE-153 exposure.

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