HHS Public Access

Author manuscript

J Environ Health. Author manuscript; available in PMC 2021 November 02.

Published in final edited form as:

J Environ Health. 2020 September ; 83(2): 38–41.

The Anniston Community Health Survey

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Editor's Note:

As part of our continued effort to highlight innovative approaches to improve the health and environment of communities, the *Journal* is pleased to publish regular columns from the Agency for Toxic Substances and Disease Registry (ATSDR) at the Centers for Disease Control and Prevention (CDC). ATSDR serves the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. The purpose of this column is to inform readers of ATSDR's activities and initiatives to better understand the relationship between exposure to hazardous substances in the environment, its impact on human health, and how to protect public health.

The conclusions of this column are those of the author(s) and do not necessarily represent the official position of ATSDR or CDC.

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Background

The city of Anniston is located in northeastern Alabama. According to 2018 U.S. Census estimates, the total population in Anniston was nearly 22,000, with Blacks comprising the majority race (50%). Anniston is the site of a production facility that produced polychlorinated biphenyls (PCBs) from 1929–1971. In 1935, the facility was purchased by the Monsanto Company that owned and operated the plant until 1997. PCB production in the Anniston plant ceased in 1971 with a ban on PCB manufacturing in the U.S. occurring

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shortly thereafter in 1977 (Agency for Toxic Substances and Disease Registry [ATSDR], 2006).

The term PCB refers to any of the 209 PCB configurations, known as congeners, with 1—10 chlorine atoms attached to a molecule composed of two benzene rings (biphenyl). There are no known natural sources of PCBs in the environment. Although some PCBs are volatile and can exist as a vapor in air, PCBs have no known smell or taste. PCBs were widely used as coolant fluids in transformers, capacitors, and electric motors, and in numerous other industrial applications because they are good insulators and do not burn easily. Many commercial PCB mixtures were known in the U.S. by the trade name Aroclor (ATSDR, 2019).

In general, PCBs are lipophilic and are stored in adipose tissue, serum, blood plasma, and human milk (Brown & Lawton, 1984). PCBs are persistent, bioaccumulative and have half-lives greater than 10 years (Ritter et al., 2011). Health effects that have been associated with exposure to PCBs include acne-like skin conditions in adults and neurobehavioral and immunological changes in children. Additionally, PCBs are known to cause cancer in animals (ATSDR, 2019).

During historical production, PCBs could have dispersed in Anniston via air transport (Hermanson & Johnson, 2007) and movement of contaminated soils and water (Alabama Department of Public Health [ADPH], 1996; ATSDR, 2000a, 2000b). During the years of PCB production in Anniston, there were no federal or state regulations governing the manufacture, sale, distribution, disposal, or cleanup of PCBs. An estimated 1 million pounds of PCB-containing solid and liquid waste was deposited in unlined and uncapped landfills south and west of the Monsanto facility (ADPH, 1996). The Anniston community was concerned about all health outcomes, especially cancer, that could possibly impact their health.

In 2003, the Agency for Toxic Substances and Disease Registry (ATSDR) funded the Anniston Environmental Health Research Consortium (AEHRC), a university and community partnership charged to address the community health concerns about PCBs in Anniston. Through a cooperative agreement with Jacksonville State University and the University of Alabama at Birmingham, the Anniston Community Health Survey (ACHS I) was conducted in 2005–2007. The follow-up study, ACHS II, was funded by the National Institutes of Health (2011–2017) and was conducted in 2014.

ACHS I and ACHS II Program Overview

Under the guidance of AEHRC, the cross-sectional ACHS I study was conducted in 2005–2007 to explore exposure to PCBs and organochlorine pesticides and health outcomes among residents of Anniston. A two-stage stratified random sampling was used to select 3,202 households from a list of residential addresses within the Anniston city limits. Addresses were intentionally oversampled in west Anniston where the former PCB manufacturing facility was located (Figure 1). Oversampling of west Anniston's eligible participants facilitated enrollment of more residents who lived closer to the plant and thus

had a higher potential for PCB exposure. Of the addresses identified, 489 were vacant or nonresidential and 890 could not be reached after multiple contact attempts. Contact was made with a member of each of the remaining 1,823 targeted households and 713 declined to participate and 1,110 consented to participate (61% participation rate). Among each of the 1,110 consenting households, one adult resident was randomly selected to complete the survey.

A survey questionnaire was administered by trained interviewers in participant homes or a local study office. The questionnaire was used to collect information on demographics including residential history and residential proximity to the facility, general and sex-specific health histories, current medications, dietary information (including past consumption of meat from locally raised livestock, local fish, home-grown vegetables, and clay), occupational exposures, lifestyle behaviors (e.g., smoking and alcohol consumption), perceptions about environmental PCB contamination and exposure, and knowledge of the litigation against Monsanto.

Fasting blood was collected for analyses of glucose and lipids, the major 35 ortho-substituted PCB congeners, and 9 pesticides and herbicides. The PCB congeners and pesticides were measured in serum using high-resolution gas chromatography/isotope-dilution high-resolution mass spectrometry (Sjödin et al., 2004). Serum total lipids were calculated with the enzymatic summation method using triglyceride and total cholesterol measurements (Bernert, Turner, Patterson, & Needham, 2007). Blood analysis was completed at the Centers for Disease Control and Prevention's National Center for Environmental Health, Division of Laboratory Sciences in Atlanta, Georgia.

The Anniston Community Health Survey: Follow-Up and Dioxin Analyses (ACHS II) was the follow-up study to ACHS I. Of the 1,110 ACHS I participants, 765 were eligible for ACHS II. Of the remaining 580 participants, 438 were successfully contacted and 359 provided questionnaire and medication data and had their PCBs measured for the second time (57% participation rate). Dioxin-like compound measurements were successfully performed in 338 of the ACHS II participants.

Study Accomplishments

ACHS I and II were designed to examine serum PCB concentrations and a variety of health outcomes (e.g., diabetes, hypertension, stroke, kidney and liver disease, autoimmune diseases) in residents of Anniston, Alabama. The overall goal of ACHS I was to characterize PCB exposure by measuring PCB congeners in blood serum samples in residents living in close proximity to the former PCB production facility and to provide percentile distributions of ΣPCBs and individual PCB congener profiles. The goal of ACHS II was to determine if the body burden of PCBs decreased over time. The follow-up study also collected more information about dietary and other practices that might have influenced exposure to PCBs, in addition to other analytes measured, including dioxins, pesticides, and metals.

For ACHS I, associations with serum PCB concentrations were observed for hypertension, elevated blood pressure, diabetes, and serum lipid profiles (Aminov, Haase, Pavuk,

Carpenter, & Anniston Environmental Health Research Consortium, 2013; Goncharov, Bloom, Pavuk, Birman, & Carpenter, 2010; Goncharov, Pavuk, Foushee, & Carpenter, 2011; Silverstone et al., 2012). Compared with the general U.S. population, the summed serum concentrations of 35 ortho-substituted PCBs were about 3 times higher for Black ACHS participants and 2 times higher for White ACHS participants. Generally, the body burden of PCBs increased with age, regardless of race (Pavuk, Olson, Sjödin, et al., 2014).

The combined results of ACHS I and ACHS II indicate that age and race are important determinants of exposure to PCBs in Anniston residents. Additionally, the total years of residency in Anniston, specifically residency in west Anniston, is an indicator of the level of exposure to PCBs in that area. We conclude that the higher PCB exposure among Black participants compared with White participants likely reflect the influence of income and education levels, as well as residential and possibly dietary factors. (Pavuk, Olson, Wattigney, et al., 2014).

Individual PCB results with a cover letter explanation were mailed to each survey participant. For ACHS II, lipid levels, glucose and insulin, liver test, and thyroid hormone levels were also reported to participants. In both studies, participants were provided a toll-free number to ask ATSDR staff questions about their results and a phone number for their physician to ask questions or request additional literature.

As a result of continued interest and questions from the community, ATSDR prepared an Anniston Community Booklet summarizing 16 published journal articles and more than 40 frequently asked questions and answers, to be mailed to all study participants in spring 2020. The cleanup of surface soil on contaminated properties in Anniston, with replacement of surface soil, is an important action by the U.S. Environmental Protection Agency to reduce the potential for future contamination of local foods. Continuing education by the local health department or community groups to keep the community informed, in conjunction with or independent of ATSDR, could reduce anxiety concerning past exposures and minimize future exposures.

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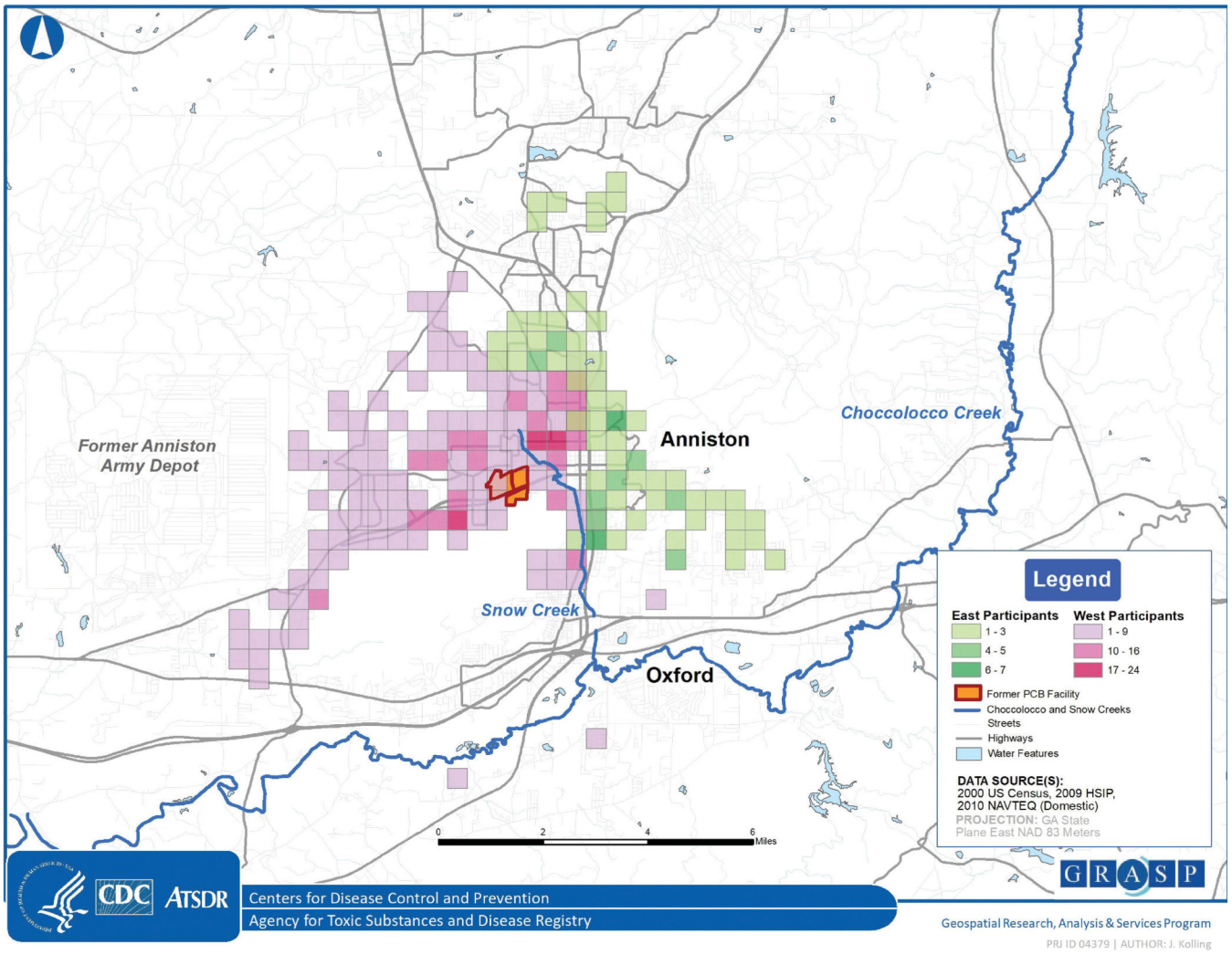

FIGURE 1.

Anniston Community Health Survey (ACHS I) Density of Participants From East and West Anniston