Environmental Contaminants Influence Gamete Development but not Hormone Profiles of Patients Undergoing IVF

L.L. Penrose, S. Khalili, D. Leung, K. Ahmad, and S.D. Prien

Department of Obstetrics and Gynecology, Texas Tech University Health Sciences Center; Lubbock, Texas 79430

Introduction

Environmental contaminants, especially endocrine-disrupting chemicals (EDCs), profoundly affect human and animal health, including reproduction. Endocrine-disrupting chemicals are defined by the U.S. Environmental Protection Agency (EPA) as any exogenous agents that interfere with synthesis, secretion, transport, metabolism, binding, action, or elimination of natural biologically active hormones that are responsible for homeostatic, neuroendocrine, and developmental processes. Endocrine-disrupting chemicals are found throughout modern life and include heavy metals, pesticides, and endocrine-disrupting chemicals (EDCs). These contaminants can have severe effects on health and development. Many of these studies have been conducted on humans who work directly with these compounds daily or on animals uterine dopamine doses to elicit a response. However, it does not show the effect of living in geographic regions of intense EDC.

Long-term passive exposure to EDCs can occur in many environments. Most Americans are exposed to some level of EDC in their food, water, and household goods. However, there is a significant regional difference in EDC levels based on regional economic activities. This phenomenon is seen in the northwestern portion of Texas, where economic activities change drastically within relatively short distances. The prairie and western region of Texas includes the Panhandle Plains, the Edwards Plateau, the Rolling Plains regions comprising all or part of 90 counties. If the region were an independent state, it would rank 353rd in size, just above Bolivia (543, 152 square miles), with a total land area of 682, 904 square miles.

The region is home to approximately 2.9 million people, with 63% of the population living in the counties surrounding the major cities. According to the United States Census Bureau, Midland, Odessa, Abilene, Wichita Falls, and San Angelo. The economic activities in these urban centers include many industries, such as oil and gas production, manufacturing, and agriculture. These economic activities have been consistently referred to as the "Petroleum Basin," and the cities of Midland, Odessa, and Wichita Falls are known for their high concentrations of oil and gas production. However, Lubbock and the surrounding areas are collectively known as the "South Plains" region, and the integrated petrochemical complex in Midland has produced approximately 4.5 million barrels of oil per day in 2020, and cumulative production of 26.9 billion barrels of oil and 79 billion cubic feet of gas as of 2018 (Figure 1).

This diverse economic activity across the region means that patients present a variety of causes of infertility. In previous research conducted at the centers in these cities, it was observed that women who were employed in certain industries, especially upon occupation or home environment. Men who live in urban areas who were also employed in these industries that were exposed to these chemicals. Women were more likely to have lower FSH levels (P < 0.001; Figure 2). In pregnancy, individuals with a history of being employed in these industries were more likely to experience lower FSH levels (P < 0.001; Figure 3). This increased FSH levels were more common in women who were engaged in these industries (P < 0.001; Figures 4 and 5). Women from rural environments who were engaged in these industries (P < 0.001; Figures 6 and 7) saw lower FSH levels than women who were employed in these industries (P < 0.001; Figures 8 and 9).

The results indicated that there is a significant difference in the concentrations of estrogenic chemicals in the maternal and paternal samples. These differences are more pronounced in rural areas and less pronounced in urban areas. There was no difference in FSH levels across the four environmental settings of interest (P > 0.05). Therefore, these findings suggest that the exposure to EDCs may influence FSH levels, but the impact is not significant enough to alter the overall conception rates. These findings are consistent with previous research that has shown a link between exposure to EDCs and changes in reproductive hormones, such as FSH. Future research should focus on identifying the specific EDCs responsible for these effects and determining the mechanisms by which they influence reproductive health.