

Effects of Parental Permethrin Exposure on Fetal and Offspring Obesity Development

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Introduction

With over one billion people diagnosed with obesity and its prevalence continuing to increase, concern about how our environment affects metabolic health has also dramatically increased (World Health Organization, 2023). One environmental factor that has gained more attention is endocrine-disrupting chemicals (EDCs) and their effects on metabolic processes. One particularly common and concerning EDC is permethrin, an insecticide used in farming (National Center for Biotechnology Information, n.d.). Permethrin's insect-repelling applications in farming have caused widespread human exposure through produce and potential leaching into local water reserves.

Substantial research has been conducted on the effects of permethrin on adult health. Additionally, recent studies have focused on the effects permethrin has on cerebrovascular and brain development. However, little is understood about its effects on offspring development, especially in relation to metabolic health and predisposition to obesity.

Aim

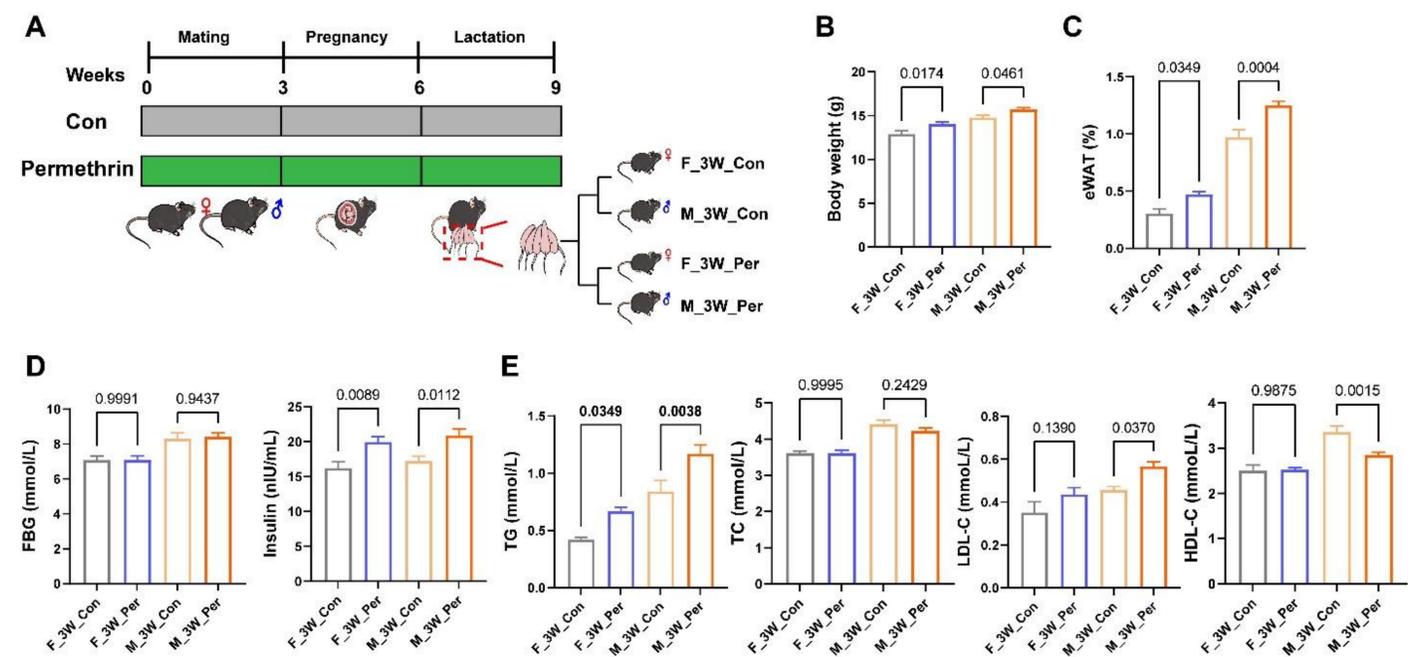
- This study aims to elucidate the influence that permethrin has on both male and female offspring throughout critical developmental stages
- It will provide us with valuable information regarding long-term health risks and future regulatory approaches to the exposure of permethrin

Methods

- During the mating process, 10-week-old female and male mice were provided with high-fat diets (HFD) supplemented with either permethrin or corn oil
- Female mice were continuously nourished with HFD enriched with either permethrin or corn oil throughout pregnancy and lactation
- The control group consisted of mice on a HFD supplemented with corn oil
- Following weaning (approximately 3 weeks after birth), the body weight of all offspring was calculated
- An 8-hour fast was performed to obtain fasting blood glucose (FBG) levels
- Offspring were euthanized to collect blood samples
- Centrifugation of blood samples allowed for the collection of blood serum
- A lipid panel was performed, and insulin levels were analyzed
- The lipid panel provided insight into triglycerides and total cholesterol, biomarkers for obesity
- High-density lipoprotein cholesterol (HDL-C) and low-density lipoprotein cholesterol (LDL-C), biomarkers for cardiovascular health, were also assessed
- The weight of white adipose tissue (eWAT) from the epididymis was measured to assess the effect of permethrin on adipose tissue
- The ratio of eWAT to body weight was calculated to standardize the measurement

Resources

National Center for Biotechnology Information. (n.d.). *Permethrin*. PubChem. U.S. National Library of Medicine. <https://pubchem.ncbi.nlm.nih.gov/compound/Permethrin#section=Use-Classification>
World Health Organization. (2023, February 23). *Obesity and overweight*. World Health Organization. <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight>



Depiction of experimental design (A), bar graph key (F_3W_Con = female_3 weeks old_Control, M_3W_Per = male_3 weeks old_Permethrin), Graph B illustrates body weight before performing 8 hour fast, Graph C illustrates weight of adipose tissue, Graphs D illustrates fasting blood glucose and insulin respectively, Graphs E illustrate triglycerides, total cholesterol, low-density lipoprotein cholesterol, and high-density lipoprotein cholesterol respectively (from left to right)

Results

- Permethrin treatment effects on adipose tissue**
- Significantly elevated the eWAT index and body weight in both males and females compared to the control group
- Permethrin treatment effects on lipid indices**
- Elevated insulin and triglyceride (TG) levels in both male and female compared to the control group
 - No effects on either male or female fasting blood glucose (FBG) or total cholesterol (TC)
 - Female low-density lipoprotein cholesterol (LDL-C) and high-density lipoprotein cholesterol (HDL-C) levels were unaffected compared to the control group
 - Increased male low-density lipoprotein cholesterol (LDL-C) levels and decreased high-density lipoprotein cholesterol (HDL-C) levels compared to the control group

Conclusion

- Permethrin has demonstrated significant impacts on offspring, even without direct consumption
 - Male offspring exhibited a more pronounced impact in promoting obesity compared to their female counterparts
- Strengths**
- Well-controlled experimental design
 - Assessed the effects on both males and females
 - Relevant to public health concerns
- Limitations**
- Small sample size
 - Experiment has not been repeated
 - No conclusive results regarding the mechanism behind the findings

Future Considerations and Experiments

- Investigate the mechanism behind the results
- Investigate the long-term effects of permethrin on obesity in both male and female offspring
 - After lactation, the offspring are no longer exposed to permethrin and are fed a high-fat diet (HFD)
 - After 6 weeks on the HFD, test the offspring's lipid panel, glucose tolerance, and weight of white adipose tissue