Chronic Alcohol Use Does Not Exacerbate the Effects of Existing Obesity in Female Mice

Mary G. Kissane, Robert D. Murphy, Jennifer L. Steiner.
Health, Nutrition and Food Sciences Department
FSU ANNE'S COLLEGE

Background

- Obesity is common in the United States, affecting more than 40% of adults.
- It is characterized by metabolic dysfunction due in part to excess adipose tissue.
- This dysfunction disrupts normal regulation of:
  - Energy balance
  - Blood glucose levels
  - Lipid metabolism
- Over half of U.S. adults also consume alcohol, and low doses of alcohol may provide metabolic benefits, including:
  - Improved insulin sensitivity
  - Potential resistance to weight gain (Paulson, 2010)
- However, the effects of chronic high-dose alcohol consumption under obese conditions remain largely unknown.

Aims of the Research

- Determine the effects of alcohol consumption on whole body metabolism in mice with pre-existing diet-induced obesity and investigate its effects on body weight and metabolic status.
- To explore how chronic alcohol consumption affects adipose tissue gene expression in obese female mice.

Research Design/Methods

- Female mice consumed either a low-fat diet (LFD) or high-fat diet (HFD) for 15 weeks prior to alcohol exposure.
- After 15 weeks, mice were divided into four groups:
  - LFD Control (LFC)
  - LFD EtOH (LFE)
  - HFD Control (HFC)
  - HFD EtOH (LFE)
- Ethanol (EtOH) groups received alcohol for 27 weeks, while control groups received water only.
- Ethanol was introduced in drinking water with increasing concentrations:
  - 5% v/v EtOH for 3 days
  - 10% v/v for 3 days
  - 15% v/v for 4 days
  - 20% v/v for the remaining 26 weeks
- Mice were sacrificed at 43 weeks for tissue collection.
- White adipose tissue (WAT) was collected.
- mRNA expression was measured in adipose tissue.
- Adipose gene expression was analyzed using PCR.

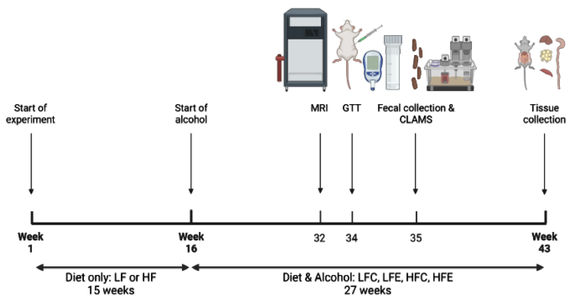

Figure 1. Experimental design and timeline of diet and alcohol exposure in female mice. Female mice were fed low-fat or high-fat diets for 15 weeks, followed by 27 weeks of alcohol or water treatment across four groups (LFC, LFE, HFC, HFE). Metabolic testing was conducted during the study and tissues were collected at week 43.

Results

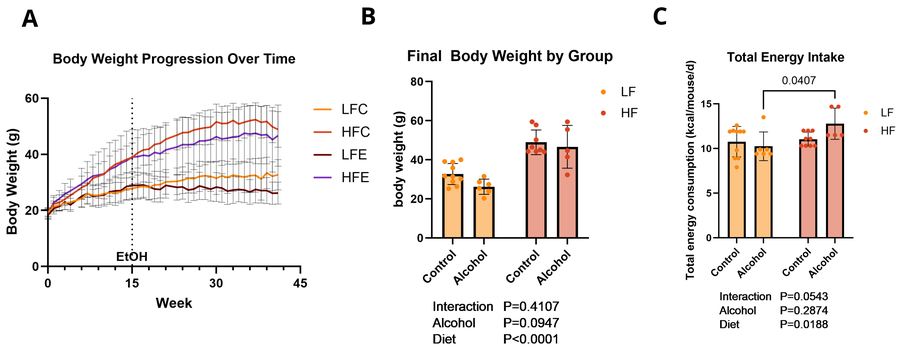

Figure 2. Body weight progression, final body weight and total energy intake. Body weight was tracked weekly across the study (A), with final body weight (B) , and total energy intake (C) compared at study endpoint across the four groups. LF Control (LFC), n=10. LF EtOH (LFE), n=6. HF Control (HFC), n=8. HF EtOH (HFE), n=5.

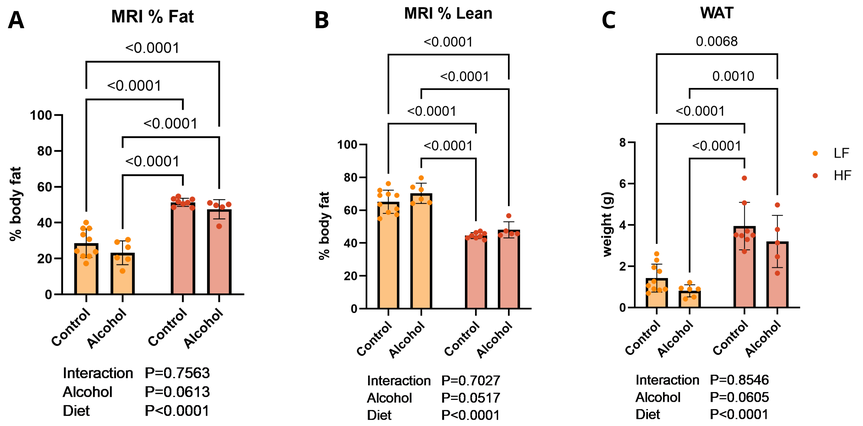

Figure 3. Body composition and adiposity. MRI-derived body fat percentages (A), lean mass percentages (B), and white adipose tissue (WAT) (C) weight were compared across all four groups. Mice fed HFD displayed significantly greater fat mass and WAT weight, and lower lean mass relative to LFD groups regardless of alcohol exposure. Two-way ANOVA was performed to determine main effects of diet (ME: diet) or alcohol (ME: EtOH), with significance set to p<0.05. Brackets indicate significant pairwise comparisons and corresponding p- values. LF Control, n=10. LF EtOH, n=6.HF Control, n=8. HF EtOH, n=5.

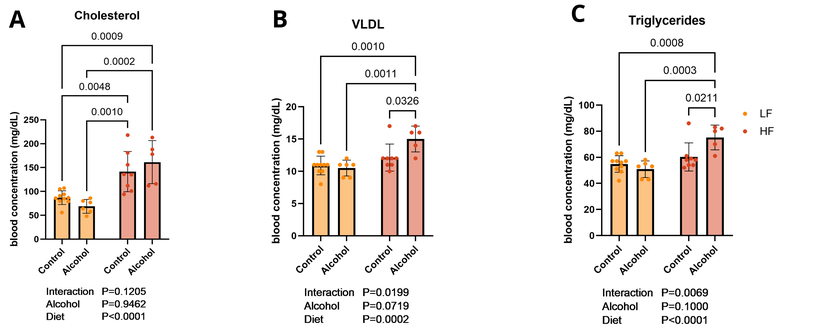

Figure 4. Circulating lipids. Concentrations of total cholesterol (A), very low-density lipoprotein (VLDL) (B), and triglycerides (C) were measured at study endpoint for all four groups. Two-way ANOVA was performed to determine main effects of diet (ME: diet) or alcohol (ME: EtOH), with significance set to p<0.05. LF Control, n=10. LF EtOH, n=6.HF Control, n=8. HF EtOH, n=5.

Results

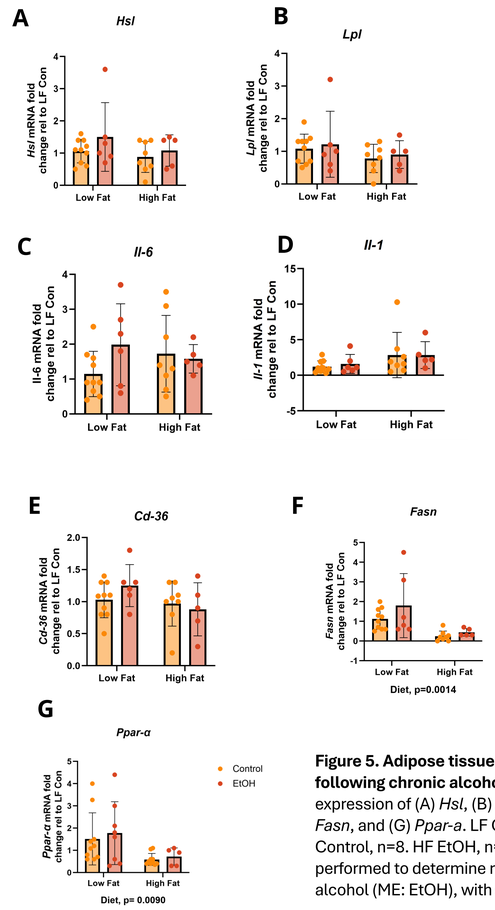

Figure 5. Adipose tissue gene expression in female mice following chronic alcohol and diet exposure. mRNA expression of (A) *Hsl*, (B) *Lpl*, (C) *Il-6*, (D) *Il-1*, (E) *Cd-36*, (F) *Fasn*, and (G) *Ppar-a*. LF Control, n=10. LF EtOH, n=6. HF Control, n=8. HF EtOH, n=5. Two-way ANOVA was performed to determine main effects of diet (ME: diet) or alcohol (ME: EtOH), with significance set to p<0.05.

Conclusion

- Long-term HFD induced obesity led to clear metabolic dysfunction in female mice.
- This was reflected by:
  - Increased body weight and fat mass
  - Impaired glucose tolerance
  - Elevated blood lipids (cholesterol and triglycerides)
- These effects occurred regardless of alcohol intake.
- In adipose tissue, HFD reduced expression of *Ppar-a,* and *Fasn,* suggesting reduced lipid synthesis and adipogenesis.
- The increased circulating triglycerides and VLDL observed in HFE mice is not likely related to changes in adipose tissue gene expression.
- Chronic alcohol consumption did not significantly worsen HFD-induced changes in adipose gene expression nor alter body weight or overall metabolic outcomes.

Acknowledgements

FSU- Department of Nutrition and Integrative Physiology Catalyst Grant Award to JLS.

Biorender was used to create experimental design image.