How Does The Prenatal Stress of Women During Pregnancy Affect The Immune Response Within Their Offspring

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Background & Objectives

- Prenatal stress has been linked to changes in brain development and behavior in offspring, including increased anxiety, depression, and ADHD.
- Prenatal stress also impacts the immune system of developing fetuses, increasing the risk of allergies, asthma, and other immune-related disorders; this can lead to altered cytokine production and decreased immune effectiveness (2).
- Our research is crucial as there is a paucity of data on pregnancy and stress, highlighting the need for further research in this area.
- The primary objective of this study is to investigate the link between prenatal stress experienced by pregnant women and immune responses in their offspring, specifically emphasizing interleukin cytokine levels.
- We hypothesize that prenatal stress within pregnant women will significantly deregulate the concentrations of interleukin cytokines; caused by hormonal imbalances which will affect the immune system.

Results & Findings

- Cytokine concentrations **IL-1, IL-2, IL-6, and IL-17 exhibit statistically significant** correlations with stress levels, as evidenced by their p-values falling below the designated threshold of 0.05 in the Wilcoxon signed-rank test.
- Conversely, cytokine concentrations **IL-4 and IL-10 exhibit statistically insignificant** correlations with stress levels, as evidenced with p-values above the designated threshold (a=0.05).

Cytokine	Mean Cytokine Concentration For Nonstressed	Standard Deviation	Mean Cytokine Concentration For Prenatally Stressed	Standard Deviation
IL-1	1.216 (pg/mL)	0.7212366	2.08625 (pg/mL)	0.998083
IL-2	7.937692 (pg/mL)	4.319433	4.3775 (pg/mL)	1.707441
IL-4	79.698 (pg/mL)	12.59076	73.3325 (pg/mL)	6.165362
IL-6	5.98e-05 (pg/ug total protein)	1.55606e-05	5.22e-05 (pg/ug total protein)	5.402596-06
IL-10	2.4325 (pg/mL)	1.702907	0.925 (pg/mL)	1.166726
IL-17	287.2375 (pg/mL)	102.0531	154.5825 (pg/mL)	9.65879

Table 1. Referenced mean concentrations with standard deviation of cytokines for nonstressed and prenatally stressed mice groups.

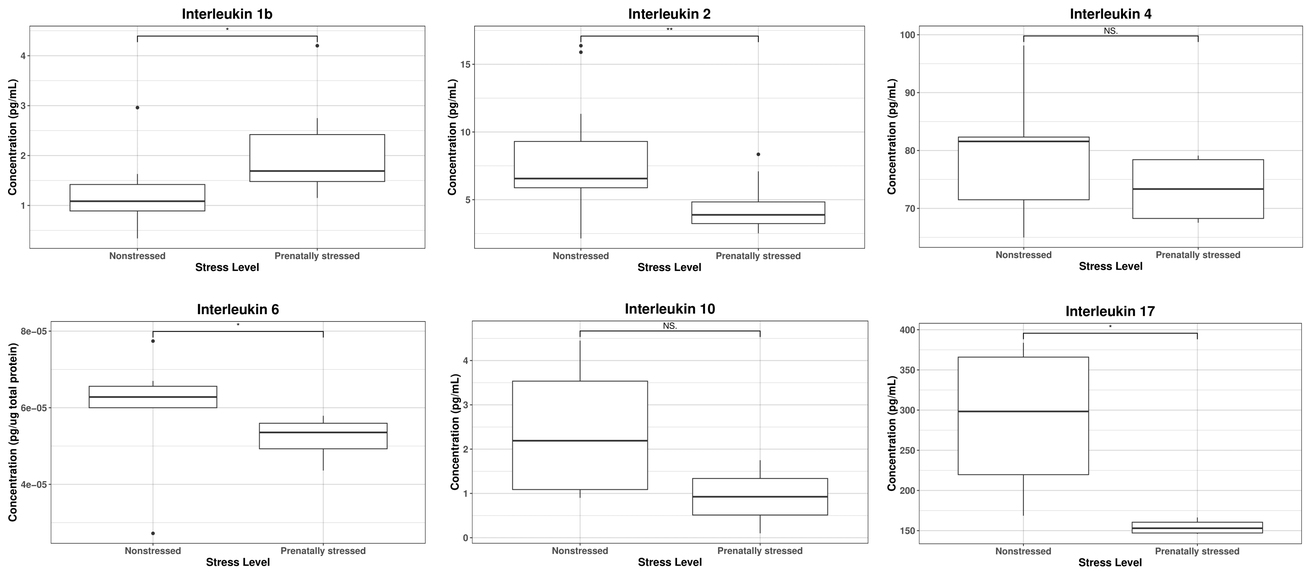

Figure 1. Boxplots showcasing comparison of concentrations for six individual interleukin cytokines with respect to stress leve
Note. * = 0.01 < p <0.05, ** = p<0.01, NS. = *insignificant*

Methods

- Analyzed a dataset of cytokine concentrations in the offspring of mice from an experiment conducted at the University of Iowa (1). The experiment involved two groups of mice: group 1 experienced periodic thermal stress during pregnancy, while group 2 did not. Upon birthing, cytokine concentrations were calculated in the maternal serum, forebrain, and placenta.
- Interleukin concentrations of the following proteins were taken into consideration: **IL-1, IL-2, IL-4, IL-6, IL-10, and IL-17.**
- Statistical analyses compared the average cytokine concentrations in pregnant mice that experienced prenatal stress to those that did not.
- Shapiro-Wilk and Levene's tests used to assess normality and variance. As the data did not follow a normal distribution and there was unequal variance, the Wilcoxon signed-rank test was used.

Discussion

- Our analysis revealed a **significant relationship between the interleukin cytokines present in offspring and the prenatal stress experienced by their mother**, as cytokines concentration levels of IL-1, IL-2, IL-6, and IL-17 had correlations with stress levels.
- Explanation for our findings is that stress triggers the release of cortisol, which can suppress the production of white blood cells, leading to an increase in the activity of pro-inflammatory interleukin cytokines that may alter the cytokine concentrations in offspring.
- The dataset used in this study was limited due to several factors, including the use of pregnant mice, limited separation between male and female offspring, and the testing of different sample types.
- Future studies should aim to use human subjects to provide more relevant information about the impact of maternal prenatal stress on cytokine levels in human offspring.
- Such studies could yield valuable insights into how to mitigate the negative effects of prenatal stress on fetal development and improve overall human health.

References

1. Gumusoglu, Banu; Maurer, Sara; Stevens, Hanna (2022), "Maternal prenatal restraint stress effects on immune factors in mice", Mendeley Data, V3, doi: 10.17632/5tfj857sb2.3ANCI
2. Christian, L. M. (2019). Psychoneuroimmunology in pregnancy: Immune pathways linking stress with maternal health, adverse birth outcomes, and fetal development. Neuroscience & Biobehavioral Reviews, 107, 96-106.

- ***Supplementary references available upon request.***