

Does Gender Impact the Immune Response of Chicks?

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Summary and Implications

Sequencing technology allows us to see how the gene expression of each gene changes under different treatment conditions. In this study, chicks of two inbred lines were challenged with Newcastle Disease Virus (NDV), a pathogen with devastating impacts on poultry throughout the world. At each of the three time points post-infection, one-third of the chicks were sacrificed and their lungs were harvested. When comparing males and females infected with NDV, differences in gene expression that were predicted to impact growth and apoptosis were identified. Differences between the response of males and females to viral challenges could be useful information for production operations. The interaction between production traits and immune related traits require further study.

Introduction

Genetic differences between individuals can result in varying susceptibility to disease. If these genetic differences can be identified, those that are beneficial could be selected for. Losses due to diseases in chickens are substantial, and NDV is a major cause of loss due to mortality and lost production. Around the world, people depend on poultry for nutrition and monetary value; NDV compromises the welfare of these people. Breeding for disease resistance is a sustainable way to mitigate this situation.

Changes in the abundance of messenger RNA (mRNA), the intermediary between DNA and protein, give insight into functional changes in a tissue. This functional information can reveal which genes are more highly or lowly expressed when comparing two groups. To identify genes that are associated with resistance to NDV, the level of expression of all genes across the genome was analyzed in two inbred chicken lines, one resistant and one susceptible, after challenge with NDV.

At an early age there is thought to be little difference between males and females in their response to disease. Unexpectedly, gender had a large impact on the lung RNA-sequence data. This difference should be explored to better

understand how males and females differ in their response to disease.

Materials and Methods

The mRNA was isolated and sequenced from the lungs of 48 chickens of 2 lines, at 3 time-points post-infection (2, 6, and 10 days-post-infection), and in two treatment groups (challenged or non-challenged). The numbers of males and females were roughly balanced between these groups. The sequence reads were filtered for quality and aligned to the chicken genome. The number of sequence reads that aligned to a specific gene showed the expression level of that gene. The number of sequence reads aligned to each gene were statistically analyzed to determine if there was a statistically significant difference in the expression of a gene between birds from two groups. This type of gene is termed a differentially expressed gene (DEG).

The males and females challenged with NDV were directly compared to determine for which genes the mRNA expression in the lung differed between the two genders. The DEGs between males and females were entered into the Ingenuity Pathway Analysis program to identify gene expression patterns.

Results and Discussion

There were 454 DEGs between the challenged males and females from all time points post-infection. The differences in gene expression of eight genes (NOV, SLC1A3, CAST, HMGCR, IL6ST, LAMA2, GHR, CAMK4) in males and females was predicted to lead to relatively more apoptosis (programmed cell death) in females and relatively more growth in males (Figure 1). At three weeks of age, it was interesting to see that gene expression in the lung suggests different growth predictions between males and females. Increased growth and decreased apoptosis, as observed in males, may be directly related. The host uses apoptosis as a self-destruct mechanism to prevent the spread of the virus to other healthy cells. Apoptosis may also have a negative effect on growth. If cells are dying prematurely, energy must be spent to regenerate those cells and then cannot be used for growth. This assumes that there is a finite amount of energy that can be used for different bodily functions.

These results demonstrate that there are differences between males and females in the gene expression of the lung already at a young age. More research is required to determine the full impact gender may have on the immune response of the chicken.

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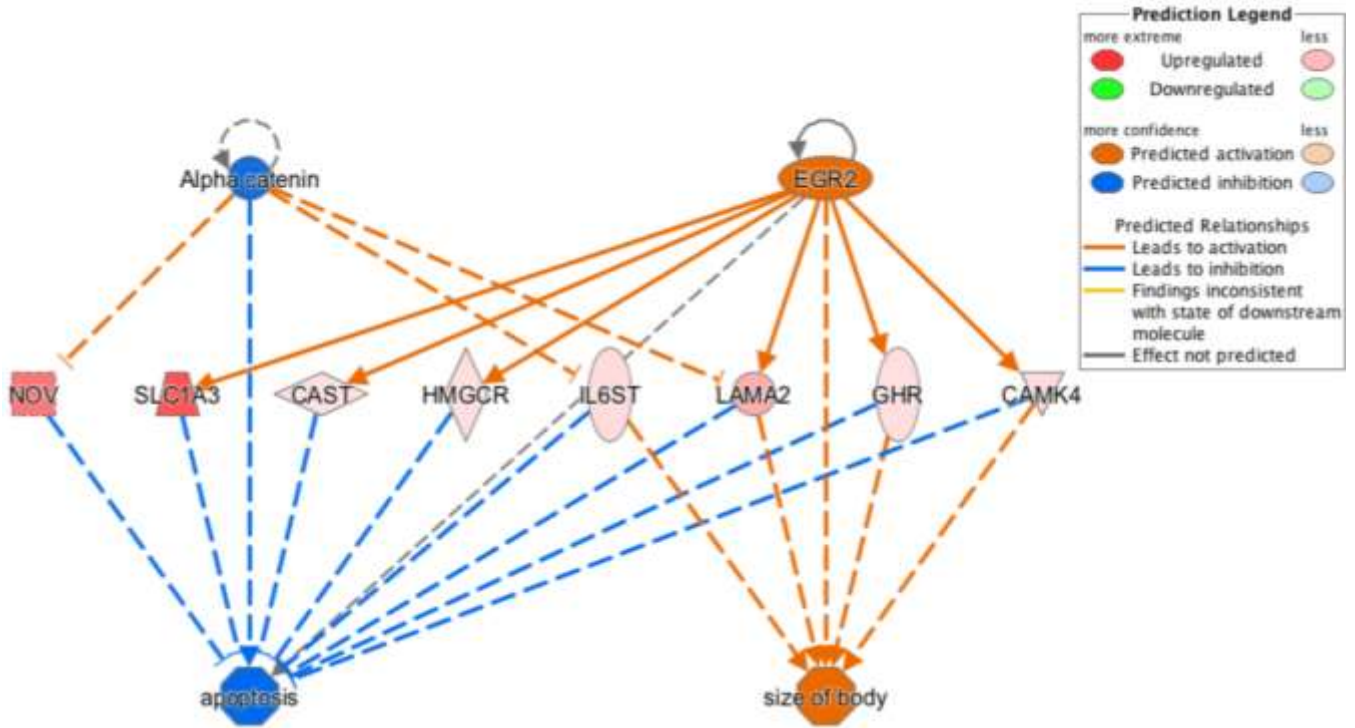


Figure 1. Differences in gene expression between males and females was predicted to impact apoptosis and body size. This regulator effect map shows the relatively higher expression of these eight genes (red) in males is predicted to be caused by the inhibition (blue) of alpha catenin and activation (orange) of EGR2 and will result in the inhibition of apoptosis and activation of body size or growth. The connectors show activation (orange) or inhibition (blue) in either a direct (solid) or indirect (dashed) manner.