PRRSV infection during gestation eliciting changes in piglet sickness behaviors following an immune challenge

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Introduction

- Yearly, hundreds of millions of dollars are lost due to outbreaks of porcine reproductive and respiratory virus (PRRSV) that hinder production.
- Maternal immune activation (MIA) from a PRRSV outbreak may also hinder the offspring performance, adding to the overall losses (1).

Objectives

Assess the effects of PRRSV infection during the third trimester of gestation on piglet behaviors:

- After secondary stressor later in life
- In males (M) vs. females (F)

Methods

- PRRSV-negative Camborough gilts (n=11) were inseminated at 235 days of age.
- Six gilts were intranasally inoculated with PRRSV on gestational day 76 (PRRSV group) and the other half were inoculated with saline (Control group) during the third trimester.
- 51 piglets were weaned on postnatal day (PD) 21 and subsequently group housed.
- At PD60, piglets were randomized by sex to receive an intraperitoneal injection of Poly(I:C) representing an immune stress similar to a viral infection or were given Saline.
- Post injection, laying, panting, standing, and other behaviors were collected by instantaneous scan sampling at 5-min intervals for 60 minutes by a trained experimenter blinded to the experimental design and totaled 624 observations.
- A logistic generalized mixed effect model was used in the statistical software SAS v 14.2. (2)
  - Fixed effects included gilt challenge, piglet treatment, sex, and the interactions
  - Random effects included gilt and a repeated measurements model within piglet
- All animal care and experimental procedures followed the National Research Council Guide for the Care and Use of Laboratory Animals and were approved by the University of Illinois Institutional Animal Care and Use Committee.

Results

Table 1. Estimates (Est) and standard error (SE) of behavior probabilities by group defined by the combination of immune treatment (Poly(I:C) or Saline) and sex for piglets from Control gilts

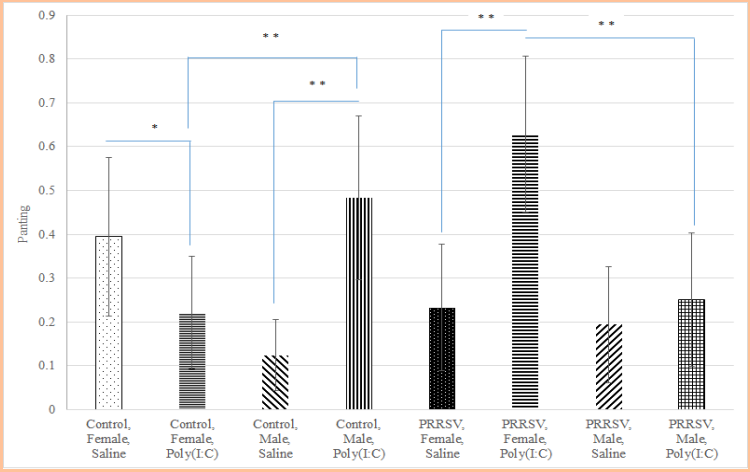
	Female				Male			
	Saline		Poly(I:C)		Saline		Poly(I:C)	
Behavior	Est	SE	Est	SE	Est	SE	Est	SE
Drinking/ Eating	0.04^^	0.03	0.05	0.03	0.17***^^	0.06	0.05*	0.04
Lateral Laying	0.14**	0.07	0.02**	0.02	0.06	0.03	0.04	0.03
Sternal Laying	0.43	0.08	0.54	0.07	0.55	0.07	0.59	0.08
Total Laying	0.62	0.08	0.59	0.07	0.63	0.06	0.66	0.07
Lethargy	0.59	0.08	0.60	0.07	0.63	0.07	0.66	0.08
Panting	0.39**^^^	0.18	0.22**^^^	0.13	0.12***^^^	0.08	0.48***^^^	0.18
Playing	0.27**	0.10	0.13**	0.06	0.15	0.06	0.13	0.06
Sitting	0.03	0.02	0.04	0.02	0.06	0.03	0.05	0.03
Standing	0.25	0.08	0.28	0.07	0.23	0.07	0.21	0.07
Touching	0.44*	0.09	0.30*	0.07	0.47***	0.08	0.19***	0.06
Walking	0.33^^	0.10	0.25	0.08	0.16^^	0.06	0.15	0.06

Table 2. Estimates (Est) and standard error (SE) of behavior probabilities by group defined by the combination of immune treatment (Poly(I:C) or Saline) and sex for piglets from PRRSV gilts

	Female				Male			
	Saline		Poly(I:C)		Saline		Poly(I:C)	
Behavior	Est	SE	Est	SE	Est	SE	Est	SE
Drinking/ Eating	0.01^^	0.01	0.03	0.02	0.19^^	0.07	0.08	0.05
Lateral Laying	0.15	0.12	0.32^^	0.18	0.2	0.14	0.09^^	0.07
Sternal Laying	0.43	0.12	0.42	0.11	0.33	0.11	0.39	0.11
Total Laying	0.61**	0.09	0.79**^^	0.06	0.57	0.10	0.58^^	0.09
Lethargy	0.61	0.09	0.79^^	0.06	0.56	0.10	0.58^^	0.09
Panting	0.23***	0.14	0.63***^^^	0.18	0.19	0.13	0.25^^^	0.15
Playing	0.05^	0.03	0.01^^	0.01	0.16^	0.05	0.12^^	0.04
Sitting	0.07	0.04	0.08	0.03	0.01	0.01	0.05	0.03
Standing	0.14	0.08	0.07^^	0.04	0.19	0.10	0.26^^	0.11
Touching	0.32***	0.09	0.67***^^^	0.08	0.27	0.08	0.38^^^	0.09
Walking	0.27**	0.12	0.08**	0.04	0.2	0.10	0.11	0.06

***, ** and *: difference between Poly(I:C) treatment levels significant at P-value < 0.001, 0.05, and 0.1, respectively.
^^^, ^^ and ^: difference between sexes significant at P -value < 0.005, 0.05, and 0.06 respectively.

Figure 1. Estimates of panting probability (and standard error of the mean) across Poly(I:C) treatment level (Saline or 1 mg/kg), maternal immune activation (PRRSV-challenged or Control gilts), and sex (Female or Male).



- Figure 1 depicts the higher probability of panting (P-value <0.005) of females from PRRSV-injected gilts that were injected at PD60 with Poly(I:C) relative to males from PRRSV-injected gilts and all piglets form Control gilts (also seen in Table 2).

** and *: difference between treatment levels significant at P-value < 0.005 and P-value < 0.02, respectively

Results & Discussion

- Tables 1 and 2 show the differences in piglet treatment, as well as sex, separated by gilt challenge. Piglets from Control gilts presented significant differences in panting probability between treatments groups were seen in both sexes, while in piglets from PRRSV gilts, females presented a difference in panting probabilities (also seen in Figure 1).
- Females from Control gilts had significant differences between piglet treatment for lateral laying, panting, and playing with a borderline difference in touching. Males expressed a significant difference in panting and touching with a borderline difference in drinking/eating between treatment groups.
- Females from PRRSV-treated gilts expressed significant differences in total laying, panting, touching, and walking between treatment groups. Males expressed no behavioral differences in terms of piglet treatment.
- Saline injected piglets from Controls had differences between sexes in drinking/eating, panting, and walking, while their counterparts from PRRSV-treated gilts had differences in drinking/eating and borderline playing.
- Sex differences in piglets given Poly(I:C) were seen in panting from Controls and in lateral laying, total laying, lethargy, panting, playing, standing, and touching for piglets from PRRSV-treated gilts.
- The previous results are consistent with the double-hit hypothesis in rodents. These studies deduced that prenatal immune challenge can augment or reduce the vulnerability of the brain and subsequent behavioral disruption to later challenges (1, 3, 4). This is consistent with some behaviors being lessened due to MIA (panting in males), and some being heightened (laying in females).

Conclusions

Our results highlight the that the effects of an immune challenge later in life on behaviors are dependent on a piglets exposure to maternal immune activation elicited by PRRSV infection during gestation as well as sex.

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