

Barn climate advice and pig tear staining: preliminary insights into an emerging welfare indicator

van Langeveld, Kenny^{1,2}; van Staaveren, Nienke^{3,4}; Van Noten, Noémie¹; Rodenburg, Bas³; Tuytens, Frank^{1,2}

¹Animal Sciences Unit, ILVO, Mellebeke-Melle, Belgium
²Department of Veterinary and Biosciences, Faculty of Veterinary Medicine, Ghent University, Mellebeke-Melle, Belgium
³Animals in Science and Society, Department Population Health Sciences, Faculty of Veterinary Medicine, Utrecht University, Utrecht, Netherlands
⁴Campbell Centre for the Study of Animal Welfare, Department of Animal Biosciences, Ontario Agricultural College, University of Guelph, Guelph, Ontario, Canada

INTRO

TEAR STAINING (TS) IN PIGS

- Brown-red porphyrin-based stains under the eye corner (produced by Harderian gland) [1]
- **PAST:** linked to atrophic rhinitis and bad barn climate [1]
- **LAST DECADE:** TS could reflect multiple environmental stressors, beyond just barn climate
 - Such as social isolation, aggression, ... [1, 3, 5]

RESEARCH QUESTIONS

- Is a change in TS affected by bad barn climate?
- Is TS a useful welfare indicator in pigs?



Fig. 1: Graphical overview of a Finisher round (+/- 25 kg till slaughter weight), highlighting when measurements took place.

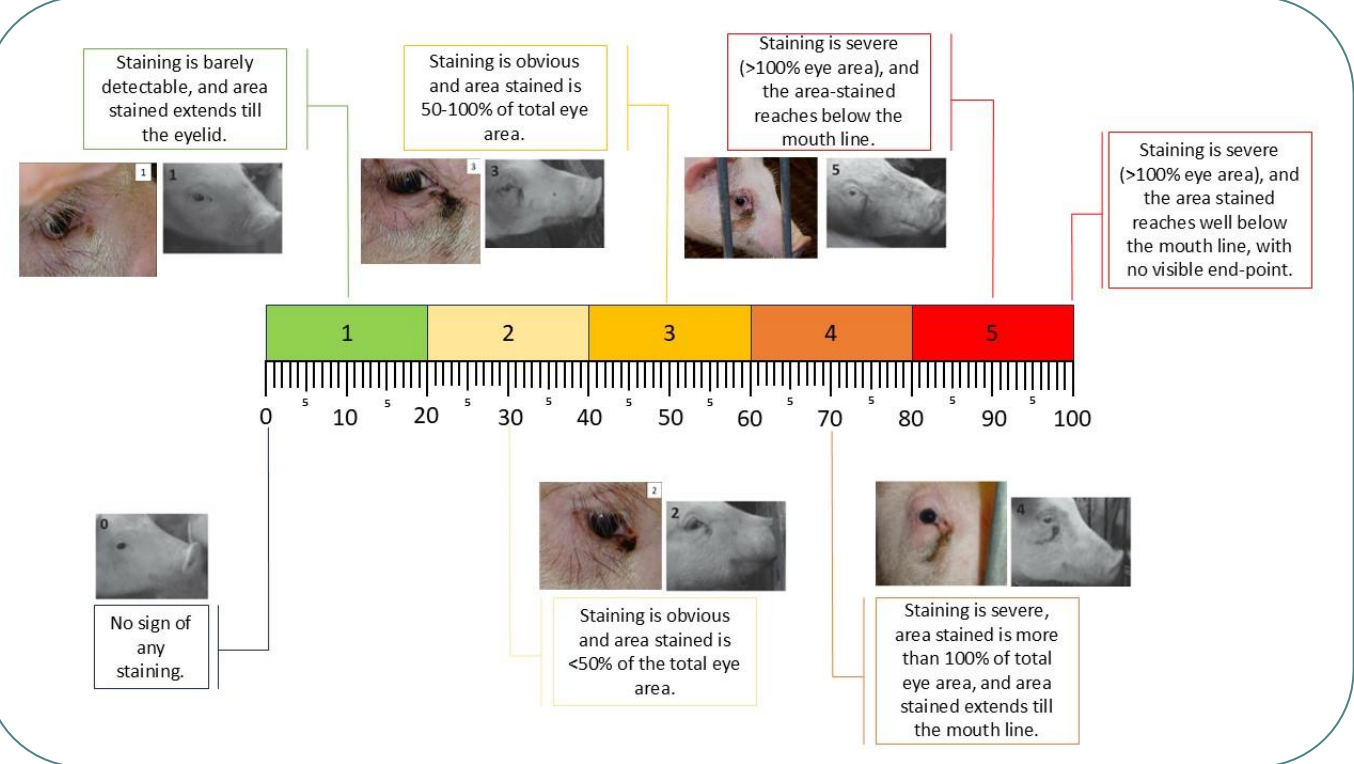


Fig. 2: tagged Visual Analogue Scale (tVAS) for Tear Staining, adapted from the discrete DeBoer-Marchand-Forde scale [1]. (Images from [1, 5])

STUDY DESIGN

- 5 Dutch farms – *Beter Leven 1 ster label*
- 1 finisher unit/farm; each with climate sensor (*Slimme Stal*, Connecting Agri&Food)
 - Measures: T° (°C), RH (%), CO₂, NH₃ (ppm); + outdoor data (nearest weather station)
- Crossover design with two rounds (*Advice (ADV)* vs. *Control (CON)*):
 - Farms blocked by start month (RND 1)
 - Randomized treatments/block (RND1); Swapped in RND 2
- Treatments:
 - **ADV:** Barn climate advice by an expert
 - **CON:** no interventions

WELFARE MEASUREMENTS (2x/round, Fig. 1)

- **Sampling:** up to 5 pens/unit, and max. 15 animals/pen
- TS (Fig. 2), TB, and lameness were scored using a tVAS (adapted from [1], [2], and [4]).
- Skin lesions were counted and summed following WQ® [6]



R&D CONTINUED

EFFECT OF BARN CLIMATE ADVICE ON THE CHANGE IN TS

- LMM: $\Delta TS (Left\ and\ Right) \sim Welfare\ Indicator (fixed) + Treatment (fixed) + Pens|Units (random)$
- **RESULTS:** Change in **Ear Lesions** is positively associated with change in **Left ΔTS** + Change in **Lameness** is positively associated with **Right ΔTS** (Fig. 5a)

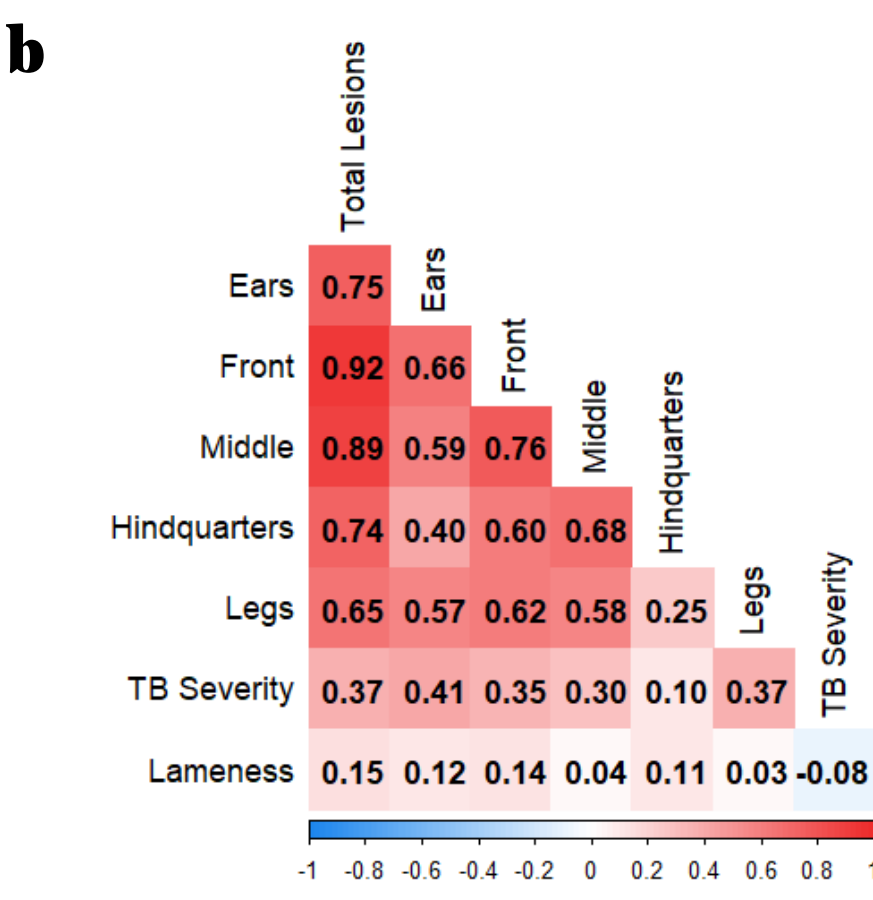
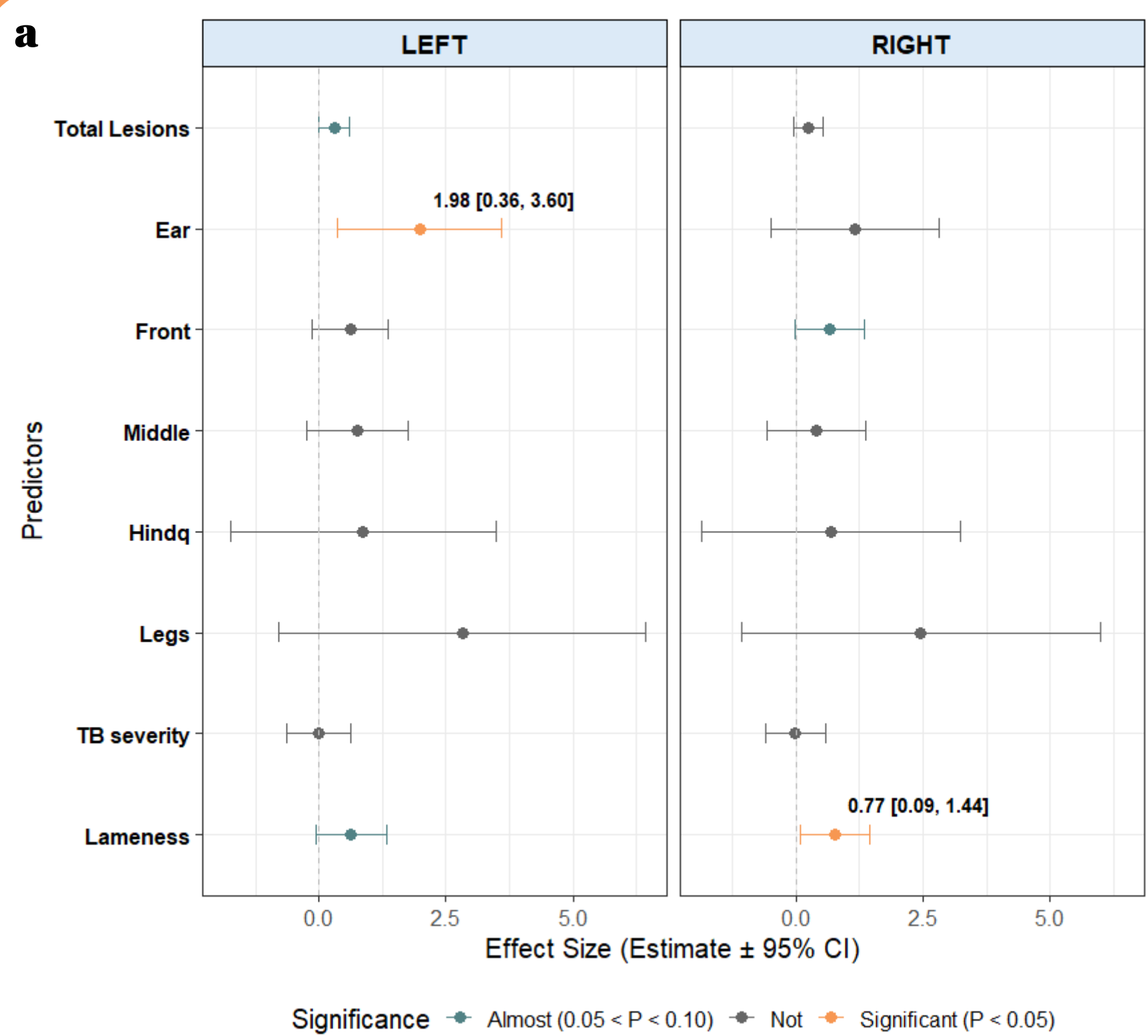


Fig. 5: Visual representation of the effect size between change in welfare indicators and TS at pen level (5 units, 21 pens/round in total) (a), and intercorrelations amongst them (Spearman's ρ correlation coefficients; excluding TS) (b). Data: 5 units, 2 rounds; 2–5 pens/unit (21 pens/round).

- **Models Output Variation:** High between-pens & -farms + large residual (unexplained) variance
 - Several (environmental) factors may jointly affect ΔTS and explain the above-mentioned levels of variation

TS AS A WELFARE INDICATOR

- **Literature:** Ear/tail lesions linked to ΔTS + Speculation for lateralization effects (Left side > Welfare relevance) [1,3,5]
- **This study:** Ear lesions associated with Left ΔTS → likely reflects total lesion burden (strong intercorrelation; Fig. 5b)
 - No strong evidence for lateralization → Both eye sides associated with Welfare Indicators
- **TS has potential as a Welfare Indicator**, but more research is needed towards its robustness, differences between eye-sides, the interplay of several factors on ΔTS , etc.

ILVO



Utrecht University



GHENT UNIVERSITY



aWISH
ANIMAL WELFARE INDICATORS AT
THE SLAUGHTERHOUSE

Funded by
the European Union

RESULTS & DISCUSSION

EFFECT OF BARN CLIMATE ADVICE ON ΔTS

- **Linear Mixed Modelling (LMM):** $\Delta TS (Left\ and\ Right) \sim Treatment (fixed) + Pens|Units (random)$
- **RESULTS:** No significant effect of Treatment on ΔTS (both eyes, $P > 0.05$; Fig. 3)

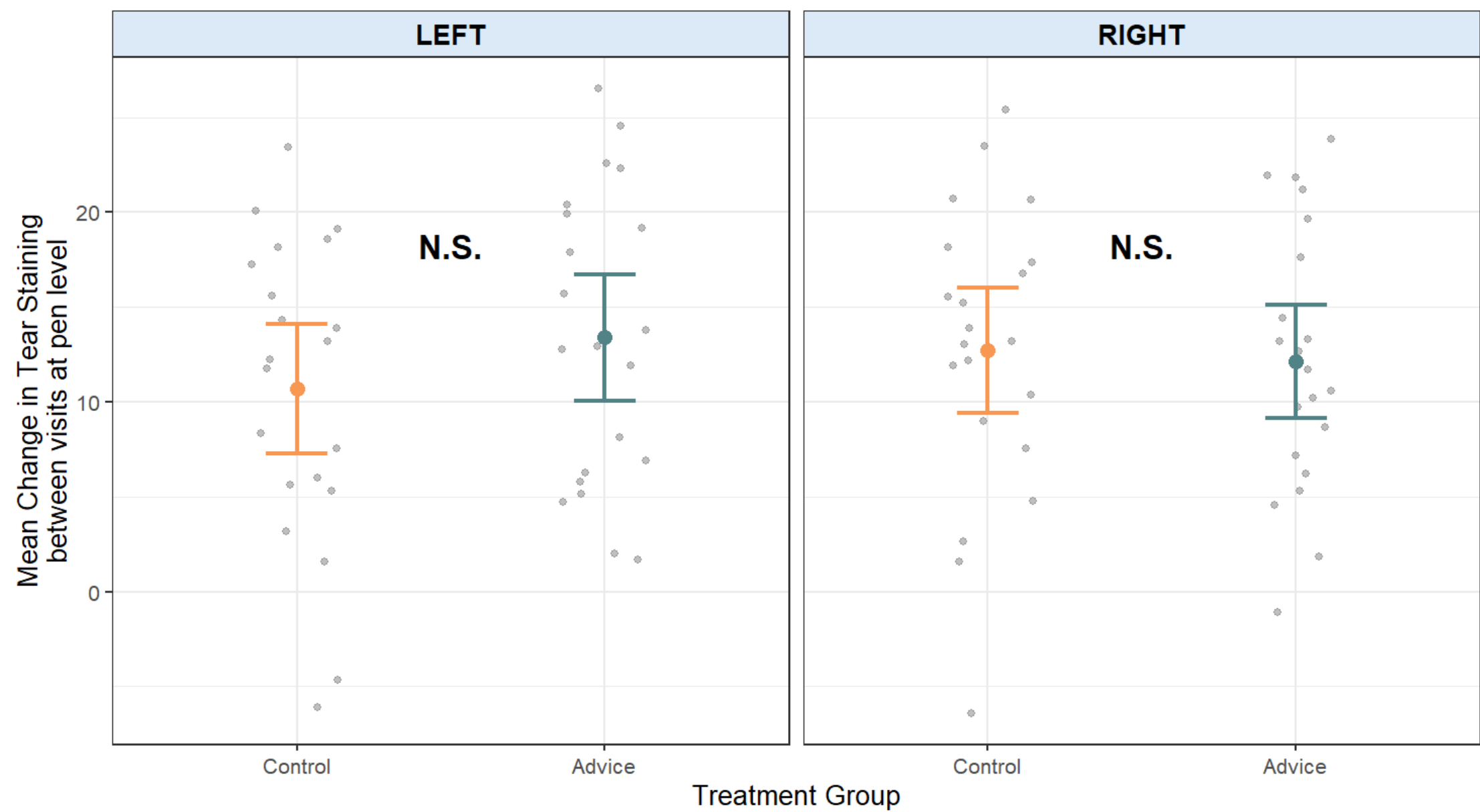


Fig. 3: Effect of ADV vs. CON on changes in tear staining (TS) between visits. Colored points and error bars show treatment means ± 95% CI, while grey dots represent individual pen-level observations across all farms and visits. Data: 5 units, 2 rounds; 2–5 pens/unit (21 pens/round).

- **Models Output Variation:** High between-pens & -farms + large residual (unexplained) variance
 - Other factors play a role in the development of TS.
 - Climate parameters? → See below
 - Welfare Indicators? → See R&D Continued

HOWEVER: TREATMENT DID AFFECT BARN CLIMATE

- LMM: Climate parameter ~ Treatment (*fixed*) + Units (*random*)
- **RESULTS:** CON exhibited, on average, more hours of elevated CO₂ (>2000 ppm) and NH₃ levels (>20ppm) (Fig. 4a and 4b)
 - Neg. Intercorrelation CO₂ (Fig. 4c) → Likely linked to reduced ventilation in colder periods (heat retention)

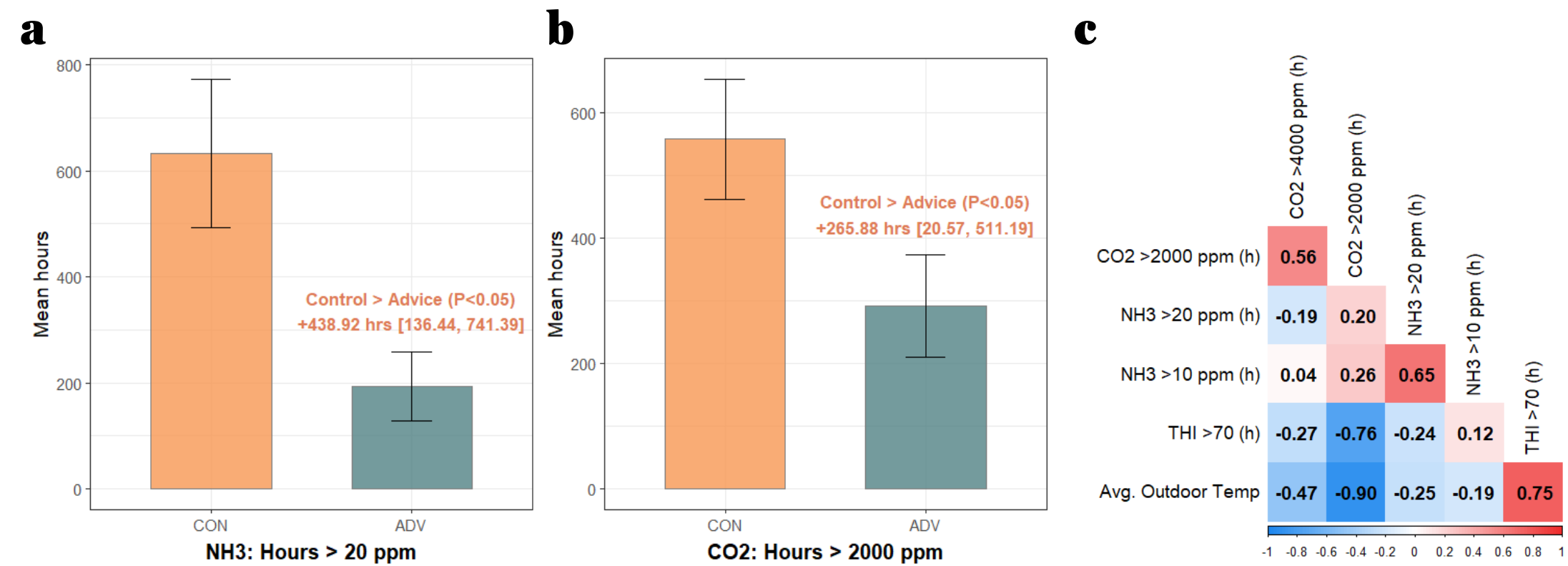


Fig. 4: Effects of ADV vs. CON on air quality and correlations among environmental indicators at the unit level (5 units, two rounds). With: a–b. Mean hours with elevated NH₃ (>20 ppm) and CO₂ (>2000 ppm) concentrations for CON and ADV. Bars show group means ± 95% confidence intervals.; c. Correlation matrix of climate-related variables (Spearman's ρ correlation coefficients).

CLIMATE VARIABLES AS PREDICTORS FOR TS

- LMM: $\Delta TS (Left\ and\ Right) \sim Climate\ Paramter (fixed) + Treatment (fixed) + Pens|Units (random)$
- **RESULTS:** No significant effect of Climate Parameters on ΔTS (both eyes, $P > 0.05$)

CONCLUSIONS

- Barn Climate Advice improved Barn Climate → did not impact Tear Staining
- TS seems to have potential as a Welfare Indicator → association with other welfare indicators
- Preliminary analysis on a limited dataset:
 - Within Larger study (10 farms, 2 rounds) where the relation between Barn Climate (Advice) and Animal welfare is assessed.



Kenny.vanLangeveld@ilvo.vlaanderen.be
awish@ilvo.vlaanderen.be

Many Thanks To:



References

1. DeBoer et al. (2015). Isolation and enrichment effects on pig welfare: tear staining and behavior. *Anim Welfare*, 24, 15-27.
2. DSBS (2017). Deutscher Schweine-Boniturschlüssel (DSBS). [Online]
3. Larsen et al. (2019). Tear staining in finisher pigs and pen-level stressors. *animal*, 13, 1704-11.
4. Nielsen et al. (2001). Mycoplasma hyosynoviae arthritis in pigs. *J Vet Med A*, 48, 475-86.
5. Telkänranta et al. (2016). Tear staining as a welfare tool on commercial pig farms. *animal*, 10, 318-25.
6. Welfare Quality® (2009). Welfare assessment protocol for pigs. Lelystad, NL.