PAPER

Assessing leg health in chickens using a force plate and gait scoring: how many birds is enough?

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Veterinary Record (2011) 168, 77
cite as doi: 10.1136/vr.c5978

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This is a summary of a paper that is published in full at veterinaryrecord.bvapublications.com

Context

The selection criteria applied to broiler chickens have improved production parameters but have increased the incidence of leg disorders. The Farm Animal Welfare Council still considers leg problems in broiler chickens to be a major welfare issue. Various methods are used to identify walking impairment in chickens, including gait scoring (GS) and force plate (FP) technology. However, neither of these methods can readily discriminate between birds that walk poorly due to pathology (which may be painful) or due to conformation (which may not cause pain).

This study examined the walking style of chickens by determining how well GS and FP techniques could predict terminal leg health, as defined by postmortem assessment. In addition, estimations were made of how many birds would need to be tested using GS or FP methods in order to accurately predict abnormalities or pathologies associated with leg health in commercial flocks.

Main conclusion

Postmortem findings of leg and foot abnormalities and significant pathologies related poorly to the GS and FP results, indicating that neither GS nor FP is a good predictor of leg health. The results of GS and FP were more closely related to one another, possibly because they both describe walking style rather than leg health itself. Neither GS nor FP could be used to accurately predict the flock-level prevalence of leg-associated abnormalities or pathologies because unfeasibly large numbers of birds would need to be sampled.

Approach

Twelve pens of approximately 90 birds were tested weekly from three to six weeks of age by both GS (using a six-point scale) and FP (a 0.6 m long platform, fitted with load cells, that records forces applied by each footstep) methods to determine the earliest age at which these methods could predict terminal (six weeks of age) postmortem findings. The best age was determined to be five weeks.

Ross 308 commercially reared chickens (n=492) were then assessed by GS and FP at five weeks of age. Birds were classified by GS as walking unacceptably (GS≥3) or not (GS 1 or 2). The FP data were classified into datasets of step-level and test-level measures, including measurements such as bodyweight, line length and the differences between left and right foot measurements. A sample of 191 birds selected to cover a range of walking styles were assessed postmortem for abnormalities (eg, footpad dermatitis, leg angles) and significant leg pathologies (eg, tibial dyschondroplasia, synovitis). The postmortem data classified the birds by whether they had any abnormality or significant pathology (ASP) or not.

Data were analysed for relationships between GS and postmortem results, FP and postmortem results, and FP and GS, using generalised linear models with logistic link function and binomial errors, with percentage mean deviance and sensitivity (Se) and specificity (Sp) used to assess goodness of fit. Stepwise selection of FP factors at the 5 per cent level was used but, due to the large number of candidate FP covariates and therefore the possibility of spurious fits, models were examined using permutation tests and bootstrap simulations were used to select the most robust models. Sample size calculations to estimate how many birds would need to be sampled from a flock using GS or FP tests to accurately predict leg health were carried out by simulations, using a normal approximation to the binomial distribution for perfect and imperfect (as defined by Se and Sp) tests.

Results

The median for mean Se and Sp for GS≥3 predicting any ASP was 0.61 (ie, only 61 per cent of birds with or without leg health abnormalities or pathologies would be correctly identified by GS). With FP predicting any ASP, this rose marginally to 0.66. At best, confidence intervals (CIs) suggest that the mean Se and Sp for any ASP to be accurately identified would rise to 0.68 with GS and to 0.75 with FP. FP was a better predictor of GS, with a median for mean Se and Sp of 0.81.

Models of ASP with GS or FP measurements as covariates left much variation unexplained, and so the number of birds that would need to be tested using these methods to assess the flock prevalence of leg abnormalities or pathologies is high. If the true prevalence of ASP in a flock was 5 per cent, then 8140 birds (corresponding to median Se and Sp), or at best 2620 birds (corresponding to upper bound of CIs for Se and Sp), would have to be tested by GS, and 3500 birds (at best 1290 birds) would have to be tested by FP, in order to accurately determine the flock-level prevalence.

Interpretation and notes of caution

The associations between leg health (as defined by ASP) and FP or GS are weak. FP and GS techniques were better predictors of one another, possibly because they both describe something more holistic about how a bird walks (which can be made up of the presence of abnormalities/pathologies, conformation, whether or not pain is experienced, and so on), and not leg health per se. The amount of FP data obtained for each bird was limited, which might be improved with repeated tests per bird. Even if the FP technique is improved, the relationship between FP and leg health may be dependent on a specific leg health problem and other factors (such as conformation), suggesting that prediction of all leg health problems using these methods is unlikely to be feasible.

Significance of findings

Neither FP nor GS techniques can easily be used to accurately estimate flock prevalence of leg-associated abnormalities or pathologies, as unfeasibly large numbers of birds would need to be tested.