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Relationships between multiple welfare indicators measured in individual chickens across different time periods and environments

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Abstract

The assessment of animal welfare requires the collection of multiple indicators of welfare but quantification of their associations in different contexts is lacking. Previous studies have examined correlations between a few indicators, but not relationships between many different indicators, or between indicators taken from the same individuals in more than one environment. We housed 60 hens for six sequential 35-day phases in different pen environments. During each phase, a series of behavioural and physiological measures was taken for every bird: body and plumage condition, surface body temperature, behaviours observed in the home pens and during test periods, tonic immobility, physiological blood profiles, and faecal sample composition. Most variation in nearly all measures was not explained by either individual bird or grouping effects but varied across phases within the birds. Acknowledging this, we examined correlations between all parameters at the phase within-bird level, selecting a conservative P-value. A consistent set of correlations showed that a slow approach response and alert behaviour in the novel object test was associated with higher bodyweight, lower body temperature and lower acute phase protein, heterophil:lymphocyte ratio and blood glucose level. A cluster analysis confirmed these correlations. Other important parameters known to be linked to the hens' environmental preference (eg comfort behaviour) were independent of the set described above. We conclude that statistical techniques can reveal patterns of independence and redundancy in the collection of behavioural and physiological measures of welfare.

Keywords: *animal welfare, cluster analysis, laying hen, multi-level modelling, stress, welfare indicator*