

Source: Proceedings of the food safety and biosecurity branch New Zealand Veterinary Association 2004 pp 101 – 106.

Use of epidemiology to assess animal welfare – advantages and disadvantages

Dr Laura Green, Ecology and Epidemiology Group, University of Warwick, Coventry CV4 7AL, UK.

Professor Christine Nicol, School of Clinical Veterinary Science, University of Bristol, Langford, BS40 5DU, UK.

Defining welfare

Animal welfare can be considered from a human perspective as an animal's physical and mental wellbeing, that is, an animal's welfare is its ability to cope with its environment assessed by its physical and mental wellbeing (Broom, 1996). It can also be considered from an animal's perspective as wellbeing as perceived by the animal. The thought process to consider this may go something along these lines: animals have subjective feelings and are consciously aware so animal disease is a welfare issue because disease in animals may be associated with pain, distress or discomfort. The capacity for conscious awareness may vary between species.

Those pro animal welfare take an ethical standpoint of granting animals the benefit of the doubt, based on cautious analogy with human experience and assume some degree of consciousness (Duncan and Fraser 1997; Nicol, 1996).

There are various definitions of animal welfare but they all share one feature, they indicate that welfare is a state of the animal that may be good or bad. Welfare *per se* is not subjective: the actual welfare of an animal is objective, although we may struggle to measure it.

Ethical frameworks

What really varies, with culture and religion, are the ethical frameworks that lead to decisions about how we react to animal welfare. Even with the same information about an animal's welfare state, cultures may react very differently. The assessment of welfare using a scientific approach may not vary very widely – e.g. we may all agree that the cortisol level of a sheep during transport is greatly elevated compared with when in a field. How we respond will have a cultural overtone – are we concerned about the sheep – that this indicator suggests a 'poor welfare state' in transit or are we more concerned about the quality of the meat from a sheep with high cortisol levels.

One reason for this depends upon whether people accept animals within their 'moral community'. If they do, then they implicitly accept that animals have interests - and that these interests affect decisions about how to house and manage them. If people do not accept animals within their moral community then they may deny that animals have any interests. There are huge variations in how strongly animal interests are weighted relative to humans. In wealthy, post-modern societies there are trends towards weighting their interests very strongly (to the point where they come to be given rights).

Even within societies where animal welfare is important we have temporal effects. We emphasise certain aspects of welfare. For example there is currently huge emphasis on levels of lameness in cattle in the UK (Main *et al.*, 2003). This is not wrong, we do have unacceptably high levels of lameness, but there is a danger that lameness is considered more important than other indicators of poor welfare e.g. mastitis. We assume that lameness causes ‘more distress’ – is this correct?

Measuring welfare

The most relevant and fundamental questions on welfare (consciousness, animal perception, mental well being) are not amenable to direct scientific investigation. We cannot measure them directly. Often we also cannot measure what it is, just what it is not. The traditional ‘five freedoms’ are freedoms ‘from’ rather than positive attributes (Table 1). Yet we know that animals may have the five freedoms but not be in good welfare.

The five freedoms (FAWC)
Freedom from hunger and thirst
Freedom from discomfort
Freedom from pain, injury and disease
Freedom to express normal behaviour
Freedom from fear and stress

Approaches to measuring welfare

There are a variety of approaches to measuring animal welfare (Mason and Mendl, 1993).

1. Welfare indicators:

The first takes measurements of basic behavioural, immune, physiological or tissue responses and compares these between groups of animals housed or treated differently. A difficulty arises in integrating this information and drawing conclusions about welfare. This generic problem is exacerbated when the various different responses do not co-vary, cannot be measured without experimenter interference, are constrained by the environment, vary greatly between individuals or by the uncertain relationship between these measures and the animals' experience of pleasure or aversion.

2. Motivational priorities:

The second approach argues that animals are able to perform their own integration of inputs and make sensitive judgements about their own best interests. This has been the rationale behind the assessment of motivational priorities using preference tests, measures of consumer demand, and the self-selection of medication. Here the problem is knowing whether an animal has been offered a choice that it is cognitively and perceptually equipped to deal with" Once indicators of poor welfare have been identified e.g. injury, and it is clear that the injury is caused directly by particular animal behaviours e.g. pecking, or biting - then the case definitions can be the behaviours themselves. In other cases, the performance of the behaviour itself may indicate an underlying welfare problem

e.g. the onset of stereotypic behaviour is almost always associated with frustrated motivation.

Why assess animal welfare?

We may wish to

1. Assess animal welfare to test quality assurance programmes that offer a minimum standard of animal welfare (Whay et al., 2003a and b; Main et al., 2003).
2. Evaluate animal welfare legislation or incentive programmes and assess their impact.
3. Develop composite measures of welfare for the above.
4. Develop measures that are indicators of welfare
5. Validate indicators of welfare
6. Optimise study designs for animal experiments
7. Study welfare in populations
8. Identify factors that improve welfare
9. Identify trigger factors for poor welfare

Using epidemiology to assess animal welfare

Epidemiology can be defined as the study of welfare in populations. It is ideal for the study of some aspects of animal welfare.

There is a huge ethical advantage in conducting epidemiological studies to identify environment, management or genetic risk factors that lead to problem behaviours. As a discipline epidemiology cannot identify the underlying mechanisms for maladaptive behaviours but we do not need to know why free range hens feather peck if we know that using the range stops them from feather pecking (Nicol et al., 2003), or why pigs tail bite if we know that straw and low stocking densities reduce its occurrence. We do need to ensure that the correct advice is given to prevent these conditions and this is more likely to occur when ethologists, behaviourists and epidemiologists work in a multidisciplinary team to ensure that relevant risk factors are investigated in an appropriate study design and that analysis and interpretation is as informative as possible.

There are also practical advantages to using epidemiology. Where the prevalence of a behaviour is relatively low (e.g. 5% crib-biting in horses) then developmental studies would require very large numbers of experimental animals - requiring space and money. In such cases, longitudinal studies of existing populations provide the only feasible way of determining cause and effect relationships. Similarly, if inducing a behaviour experimentally is either difficult (tail biting), very removed from the commercial setting or unethical (feather pecking) but the condition is common on commercial farms (approximately 50% of farmers report feather pecking in free range flocks and tail biting in pigs (Green et al., 2002; Moinard et al., 2003) then epidemiology is practical.

Through the traditional approach of observational epidemiology we can improve our understanding of a condition. Cross-sectional studies may lead to the identification of previously unsuspected associations and generate hypotheses. e.g. Results from the feather pecking cross sectional study (Green et al., 2002;

Poetzch et al., 2003) indicated among other effects that diet change affected birds possibly because it encouraged more feeding and competition, in which case advice to farmer might have been to increase trough space or because it decreased feeding and encouraged exploratory pecking elsewhere. The latter seems to be the case and suggests that farmers should consider masking novel diets with familiar odorants (Dixon et al., submitted). These hypotheses may also be tested epidemiologically with cohort or intervention studies.

Experimental scientists tend to work at a relatively small scale and will investigate the influence of factors that it is relatively easy to manipulate e.g. the role of substrate type, or perch provision in feather pecking. Farm level factors such as ventilation system, use of automated machinery, noise level from large flocks etc are virtually impossible to investigate on a small scale and intervention studies are really the only alternative; they are, however, very expensive and currently much under used.

Over the past few years we have studied aspects of animal welfare using epidemiological techniques. We have focused particularly on behavioural abnormalities tail and vulva biting in pigs and feather and vent pecking in free range hens. I will describe the latter in more detail. We asked farmers to complete a questionnaire on the last flock that they had depopulated. We asked them whether they had seen feather pecking and (to check their case definition) what they had seen – bird behaviour with their own and other birds feathers and areas of feather loss and skin damage. We then asked farmers to complete detailed questions on their management of this flock with sub headings on for example feeding, lighting, other disease. The results of this study demonstrated that farmers that reported feather pecking were also likely to report that only a small proportion of their birds used the range, that they changed the diet more than three times during lay, that several infectious diseases were more common. We then used a concurrent case control study, where 100 farms were visited, 50 as the hens started to feather peck and 50 age matched control flocks. The only factor that was statistically significantly different between the case and control flocks was that a smaller proportion of birds were using the range in case flocks. From these studies we concluded that a major factor that prevented feather pecking was use of the outdoor range. This begs the question why do some flocks use the range and not others. This is a challenging question. Anecdotally we know that many farmers do not encourage their birds to use the range because they are concerned that eggs will be laid outside. This is a great economic loss and may encourage predators (foxes).

When we have good measurable case definitions welfare is the outcome of interest. We can study visible abnormalities associated with animal welfare e.g. feather pecking, tail biting, injuries to the hock. We can study many diseases that are in GB at least, considered to be poor welfare e.g. Footrot in sheep, lameness in all production animals, mastitis in cattle. We can study the overall appearance of health by estimating body condition score (or maybe more importantly variability in body condition score) and cleanliness of the animal. All of these are observable and of sufficient time duration that in a visit to a farm we can record the abnormalities and estimate proportions of animals affected.

We can use epidemiology to investigate whether measures are assessing the behaviours that we expect. In our studies of welfare assessment of cattle we thought we could use flight distance as a useful measure of dairy cows' response to strangers. When we analysed the data we identified that there was no difference between farms but that lame cows have a shorter flight distance than non-lame cows, so our flight distance was possibly a measure of pain.

Limitations of epidemiology to assess animal welfare

Assessment of welfare *per se* is not epidemiology. One key aspect of any good epidemiological study is that the factors of interest (be they poor welfare, behavioural abnormalities, housing type, stockmanship) must be defined and measurable. We cannot use epidemiology to develop welfare assessment, only test out its success. From the above it is clear that whilst we can measure poor physical welfare e.g. bursae (Moutottou papers), disease, hock damage, poor body condition, we cannot define many of the direct measures that we would like to assess e.g. the impact of environment on mental well being. We cannot study any factor that lacks variability, that we cannot see and many of factors that are transient.

We need variability, when all farmers or owners are using the same practices (e.g. all one breed of laying hen, only one system to rear broilers) there may simply not be sufficient variation out in the real world. Nearly all domestic horses are weaned between 4 and 8 months of age in the UK. In the wild they would not be weaned by their mothers until 11 or 12 months. We cannot investigate how this later weaning would influence risk of development of abnormal behaviour.

It is difficult to assess measures that occur transiently e.g. how piglets are weaned because this procedure will be done once per week, or what proportion of dairy cows lie down correctly in cubicles because a data collecting visit will have to occur after milking and feeding. These can be done but they slow data collection and may be prohibitively expensive.

Social acceptability -?human welfare?

Epidemiology can be used to assess farmer's attitudes to management changes.

It is important to follow through with results from epidemiological studies to test their validity and also their acceptability. In our studies of tail biting in pigs where we demonstrated that presence of straw and lower stocking density were associated with absence of tail biting we contacted farmers and asked them whether they would consider providing straw or lowering stocking density to prevent tail-biting. The vast majority said they would not. They considered that these two factors would affect their profits more than the occurrence of tail-biting (unpublished data). We attempted to test provision of straw on a farm with a slurry system (with an upgraded pump) in an intervention study but unfortunately it was just set up when foot and mouth disease came into the UK. My opinion is that if we wish to prevent tail biting in pigs we will have to pay a premium or legislate to encourage farmers to change these management practices.

References

- Broom D.M. (1996) Animal Welfare defined in terms of attempt to cope with the environment. *Acta Agriculturae Scandinavica, Section A Animal Science*, Supplement 27: 22-28.
- Dixon, G., Green, L.E. and Nicol, C.J. (2004) The effect of diet change on the behaviour of layer chicks, *Gallus gallus domesticus*. *Appl. Anim. Behav. Sci* (submitted)
- Green, L. E., Lewis, K, Kimpton, A.J. and Nicol, C.J. (2000) A cross sectional study of the prevalence of feather-pecking in laying hens and its associations with management and disease. *The Veterinary Record* 147 233-238
- Main, D. C. J., Whay, H. R., **Green, L. E.** and Webster, A. J. F. (2003) Effect of the RSPCA Freedom Food scheme on the welfare of dairy cattle. *The Veterinary Record* **153** 227-231
- Main D. C. J., Clegg J., Spatz A., Green L. E. (1999) A Lameness scoring system for finishing pigs. *The Veterinary Record* 147 574-576
- Mason, G.J and Mendl, M. (1993). Why is there no simple way of measuring animal welfare? *Animal Welfare* 2: 301-319
- Moinard, C., Mendl, M., Nicol CJ & Green, L.E. (2003). A case-control study of on-farm risk factors for tail-biting in pigs. *Applied animal Behaviour Science*. 81 333-355
- Moultotou, N., and Green, L. E. (1999) Incidence of foot and skin lesions in nursing piglets and their association with behavioural activities. *The Veterinary Record* 145 160-165
- Moultotou, N., Hatchell F and Green L. E. (1999) The prevalence and risk factors associated with forelimb skin abrasions and sole bruising in preweaning piglets. *Preventive Veterinary Medicine* 39 231-245
- Moultotou, N., Hatchell, F., and Green, L. E. (1999) Prevalence and risk factors associated with adventitious bursitis in live growing and finishing pigs in south west England. *Preventive Veterinary Medicine* 39 39-52
- Moultotou, N., Hatchell, F., and Green, L. E. (1999) Prevalence of foot and limb lesions in 528 weaned pigs from 15 units on south west England. *The Veterinary Record* 144 449-451
- Moultotou, N., Hatchell, F., and Green, L. E. (1999) Foot lesions in finishing pigs and their associations with the type of floor *The Veterinary Record* 144 629-632
- Moultotou, N., Hatchell, F., and Green, L. E. . (1998) The prevalence and distribution of adventitious bursitis of the hock and its associations with foot lesions and floor type in finished pigs in south west England. *The Veterinary Record* 142 109-114
- Moultotou, N., Sterry J., and Green, L. E. . (1998) Cohort study of the association between adventitious bursitis of the hock and the age at slaughter and carcass quality in pigs on one farm. *The Veterinary Record* 142 52-55
- Nicol, C. J., Lindberg, A. C., Phillips, A. J., Pope, S. J., Wilkins, L. J. and Green, L. E. (2001). Influence of prior exposure to wood shavings on feather pecking, dustbathing sand foraging in adult laying hens. *Applied Animal Behaviour Science* 73 141-155

- Nicol, C. J., Poetzch, C. J., Lewis, K. and Green L. E. (2003). A case control study of feather pecking in laying hens. *British Poultry Science*. 44 515-523
- Nicol, C.J. (1996) Farm Animal Cognition. *Animal Science* 62: 375-391
- Poetzch, C. J., Lewis, K., Nicol, C. J., and Green, L. E. (2001) A cross sectional study of the prevalence of vent-pecking in laying hens in alternative systems and its associations with feather pecking, management and disease. *Applied Animal Behaviour Science*. 74 259-272
- Whay, H. R., Main, D. C. J., Green, L. E. and Webster A. J. F. (2003). Animal based measures for the assessment of welfare state of dairy cattle, pigs and laying hens: consensus of expert opinion. *Animal Welfare*. 12 205-217
- Whay, H. R., Main, D. C. J., Green, L. E. and Webster, A. J. F. (2003) Assessment of Dairy Cattle Welfare Using Animal-Based Measurements: direct observations and investigation of farm records. *The Veterinary Record* 153 197-202