A COMPARISON BETWEEN LEG PROBLEMS IN DANISH AND SWEDISH BROILER PRODUCTION

G Singh Sanotra*, C Berg† and J Damkjer Lund‡

* Department of Animal Science and Animal Health, Royal Veterinary and Agricultural University, Grønnegårdsvej 8, DK-1870 Frederiksberg C, Copenhagen, Denmark

† Department of Animal Environment and Health, Swedish University of Agricultural Sciences, PO Box 234, SE-532 23 Skara, Sweden

‡ The Danish Animal Welfare Society, Alhambravej 15, DK-1826 Frederiksberg C, Denmark

* Contact for correspondence and requests for reprints: sgs@kvl.dk

Abstract *Animal Welfare 2003, **12**: 677-683*

In Denmark and Sweden, surveys were undertaken to estimate the prevalence of leg problems in conventional broiler production. The Danish survey included 28 Ross 208 flocks, and the Swedish survey included 15 Ross 208 and 16 Cobb flocks. Leg problems included reduced walking ability (gait), tibial dyschondroplasia (TD), varus/valgus deformations (VV) and foot-pad dermatitis (FPD). Danish Ross chicks showed a significantly higher prevalence of gait score > 0, gait score > 2 and TD, but a lower prevalence of VV, than Swedish Ross chicks. Cobb chicks showed a significantly higher prevalence of gait score > 0, gait score > 2 and TD than Swedish Ross chicks, a significantly higher prevalence of VV than Danish Ross chicks, and a significantly lower prevalence of FPD than both Danish and Swedish Ross chicks. The two genotypes of Swedish chicks showed similar relationships between body weight and probability of gait score > 0, TD and VV, indicating that the difference in prevalence of these leg problems may be due to the difference in mean body weight at slaughter age. At body weights below 2300 g, Danish chicks showed a higher probability of gait score > 2 than Swedish chicks. Furthermore, at body weights below 1900 g, Danish chicks had a higher probability of TD than Swedish chicks, whereas at body weights above 2200 g they had a lower probability of TD. This indicates that the difference in prevalence of TD between Danish and Swedish chicks was due to differences in mean body weight at slaughter age as well as housing conditions. Therefore, further studies on the risk factors in relation to management and housing conditions are required.

Keywords: *animal welfare, broilers, gait, lameness, varus and valgus deformations, walking ability*

Introduction

Genetic selection for rapid growth, increased body weight and quantity of breast muscles, in combination with improved feed conversion in broiler chickens, gives rise to severe skeletal problems. The European Commission (Anon 2000) recognises skeletal disorders, specifically lameness or leg weakness, as the most serious welfare problem in commercial broiler production. Leg weakness results from problems in the intertarsal joints, the hips and the

knees. The prevalence of impaired walking ability corresponding to gait score > 2 can be as high as 26–30% (Kestin *et al* 1992; Sanotra *et al* 2001). A pilot study by Berg and Sanotra (2001) in Sweden showed that 14.8% of broilers had leg problems (gait score > 2).

The most common and significant skeletal disorders in broilers are tibial dyschondroplasia (TD) (Lynch *et al* 1992; Rath *et al* 1998) and 'twisted leg', also called 'varus' (inward twist) and 'valgus' (outward twist), referring to lateral angulation of the tibiotarsal articulation (Julian 1984; Sanotra 1999). Some leg deformities may be due to infectious agents — for example, femur head necrosis and joint infections (McNamee *et al* 2000; Butterworth *et al* 2002).

Leg weakness problems have serious consequences for welfare, as lame birds have difficulty reaching food and water (McGeown *et al* 1999). Birds with leg problems may feel pain while walking and may avoid performing any forms of behaviour except for sitting or lying (Vestergaard & Sanotra 1999; Danbury *et al* 2000). Ultimately birds may suffer from hunger, thirst and dehydration, and may die (Butterworth *et al* 2002). Leg problems are also an economic issue, as lame birds lose weight and are likely to be downgraded at slaughter (Yalcin *et al* 1998; Kestin *et al* 1999).

In Denmark (1999) and in Sweden (2002), surveys were carried out in order to estimate the prevalence of leg problems in broiler flocks reared under standard commercial conditions. The objective of this paper is to compare the survey results.

Methods and materials

Animals and housing conditions

The Danish survey included 28 Ross 208 broiler flocks (100 chicks per flock) representing 28 producers. The chicks were reared under 24 h constant light and with a mean stocking density of 45 kg m^{-2} at slaughter age (mean 42 days). The birds were fed *ad libitum* and had free access to water. The ventilation and housing conditions were good.

The Swedish survey included 15 Ross 208 and 16 Cobb flocks (50 chicks per flock) representing 27 producers. Two Ross producers and two Cobb producers contributed two flocks each. The chicks were reared with a mean stocking density of 36 kg m^{-2} at slaughter age (mean 35 days) and were fed *ad libitum*. The rearing conditions were as good, as in Denmark. In Sweden, however, most producers used varying light–dark schedules (2–6 h daily dark period) at the start of rearing.

Leg problems studied

During both of the studies, randomly selected birds were weighed, examined for foot-pad dermatitis (FPD) and varus/valgus deformation (VV), and assessed for walking ability according to the Bristol Gait Scoring System (Kestin *et al* 1992). After the gait performance test, each bird was euthanased and both legs were removed. The proximal ventral and dorsal tibiotarsi were examined (gross) and scored for the development of TD.

Statistical analysis

The data were analysed using the software package SAS Version 6.12. Comparisons were made of body weights and prevalence of leg problems using *t*-tests ('proc TTEST' in SAS [SAS Institute 1990]). Distributions of gait and TD scores were compared using the

https://doi.org/10.1017/S0962728600026361 Published online by Cambridge University Press

Wilcoxon two-sample test ('proc NPAR1WAY'). Predicted probabilities of leg problems as functions of body weight were calculated using logistic regression models ('proc GENMOD').

Results

Prevalence of leg problems

As shown in Table 1, comparison between Swedish Ross and Danish Ross chicks showed a significantly higher prevalence of gait score > 0 ($P = 0.007$), gait score > 2 ($P < 0.001$) and TD ($P = 0.002$) but a lower prevalence of VV ($P < 0.017$) in the Danish Ross birds. With respect to walking ability and prevalence of TD, Danish Ross chicks did not differ significantly from Swedish Cobb chicks. Danish chicks did, however, show a significantly lower prevalence of VV ($P < 0.001$) and a significantly higher prevalence of FPD ($P < 0.001$).

Swedish Cobb chicks showed a significantly higher prevalence of gait score > 0 ($P = 0.001$), gait score > 2 ($P < 0.001$) and TD ($P = 0.043$) than Swedish Ross chicks. Cobb chicks, however, showed a significantly lower prevalence of FPD ($P < 0.001$).

The mean body weights at slaughter age for Danish Ross, Swedish Ross and Swedish Cobb chicks were 1821 g, 1750 g and 1852 g, respectively. These body weights were statistically different ($P < 0.001$–0.002).

Table 1 Prevalence (%) of leg problems found in the Danish and the Swedish surveys.

Parameter	Denmark		Sweden			
	Ross 208 (n = 28 flocks)		Ross 208 (n = 15 flocks)		Cobb (n = 16 flocks)	
	Mean	SD	Mean	SD	Mean	SD
Gait score > 0	75.0	9.08	67.6	5.96	77.6	9.07
Gait score > 2	30.1	13.16	14.1	3.81	26.1	11.21
TD score > 0	57.1	15.83	45.2	7.92	56.3	13.85
Varus/valgus	36.9*	15.21	46.4	8.08	52.6	9.68
Foot-pad dermatitis	41.6*	20.05	48.5	17.75	21.6	12.26

* n = 23 flocks

Distributions of gait and TD scores

The Danish and Swedish Ross chicks differed significantly ($P < 0.001$) with respect to the distribution of gait scores (Figure 1a). In Sweden, the proportions of chicks decreased with increasing gait score, whereas in Denmark, the proportions of chicks with gait scores 0, 1, 2, 3 were nearly equal. The distributions of gait scores in Swedish Ross and Swedish Cobb chicks were significantly different ($P < 0.001$). No significant differences, however, were found between the Danish Ross and the Swedish Cobb chicks. Regarding the distribution of TD scores, similar differences were found (Figure 1b), except that in both the Danish and the Swedish chicks the proportion of chicks decreased with increasing TD score.

https://doi.org/10.1017/S0962728600026361 Published online by Cambridge University Press

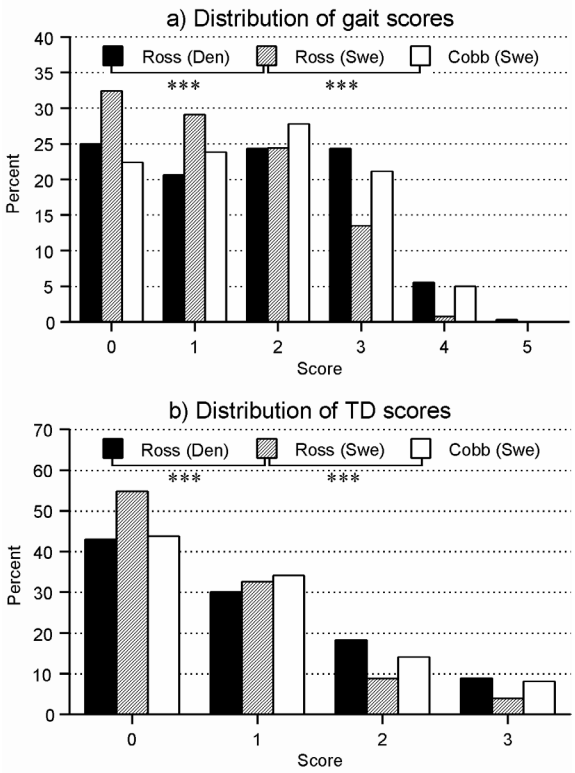


Figure 1 **Comparison of the distribution in (a) gait scores and (b) TD scores in Danish and Swedish chicks. ***$P < 0.001$**

Relationships between leg problems and body weight

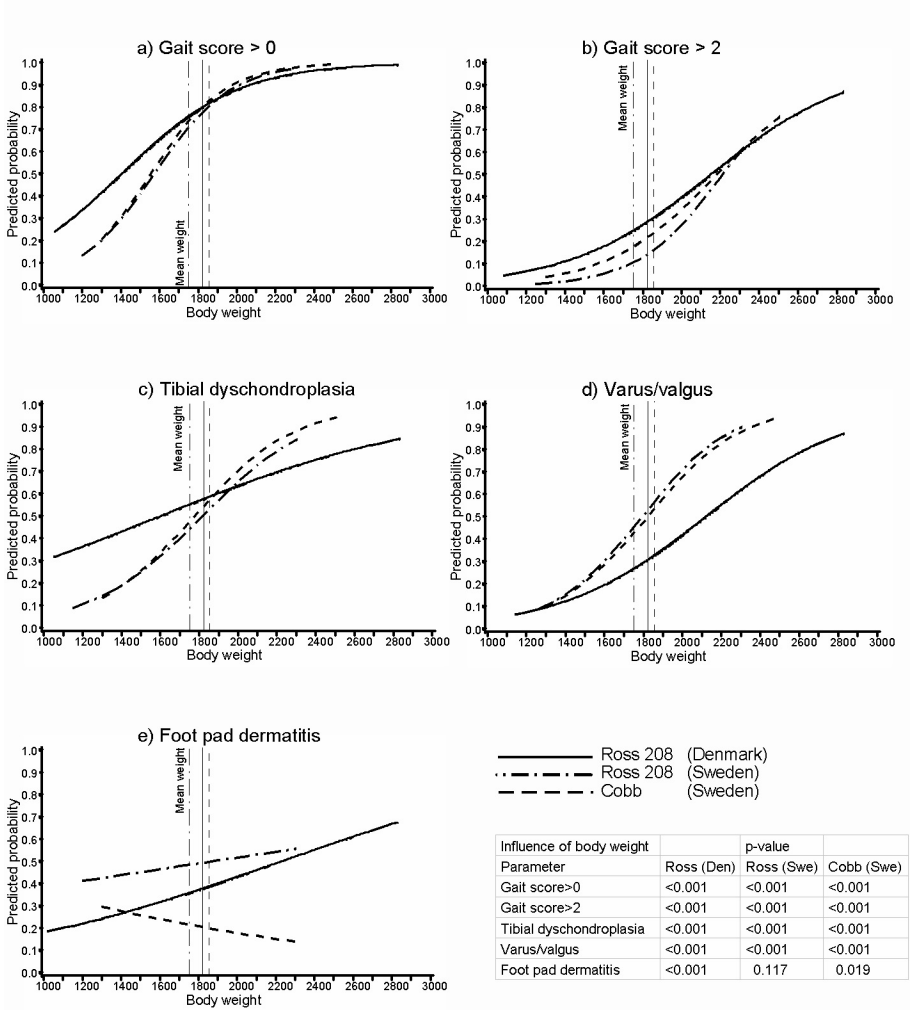
The relationships between body weight and predicted probabilities of impaired walking ability (gait score > 0), TD and VV were similar in Swedish Ross and Swedish Cobb chicks (Figure 2). For chicks with body weights below about 1800 g, the probability of gait score > 0 was higher in Danish Ross than in both genotypes of Swedish chicks (Figure 2a). For gait score > 2, Danish Ross chicks showed a higher probability than Swedish chicks when body weights were below about 2300 g (Figure 2b). Furthermore, within the same range of body weights, Swedish Cobb chicks showed a higher probability of gait score > 2 than Swedish Ross chicks.

For chicks with body weights lower than 1900 g, Danish Ross chicks had a higher probability of TD than Swedish Ross chicks (Figure 2c). For body weights higher than 2000 g, however, Danish Ross chicks had a lower probability of TD.

For chicks with body weights above 1300 g, Danish Ross chicks had a lower probability of VV than Swedish chicks of both genotypes (Figure 2d). Furthermore, the difference between Danish and Swedish chicks increased with body weight.

Generally, Swedish Ross chicks had a higher probability of FPD than Danish Ross chicks (Figure 2e). The difference between these chicks decreased with body weight. At body weights higher than 1400 g, the Swedish Cobb chicks had a lower probability of FPD than both the Danish and the Swedish Ross birds. Furthermore, in Cobb birds the probability of FPD decreased with body weight.

https://doi.org/10.1017/S0962728600026361 Published online by Cambridge University Press



Influence of body weight		p-value	
Parameter	Ross (Den)	Ross (Swe)	Cobb (Swe)
Gait score>0	<0.001	<0.001	<0.001
Gait score>2	<0.001	<0.001	<0.001
Tibial dyschondroplasia	<0.001	<0.001	<0.001
Varus/valgus	<0.001	<0.001	<0.001
Foot pad dermatitis	<0.001	0.117	0.019

Figure 2 **Predicted probabilities of leg problems as functions of body weight in Danish and Swedish chicks.**

Discussion, conclusion and animal welfare implications

The Swedish Ross and Cobb chicks differed significantly with respect to the prevalence of gait score > 0 and TD score. The predicted probabilities of these leg problems as functions of body weight, however, were similar in the two genotypes. This indicates that the difference in prevalence may be explained by the difference in mean body weight at slaughter age.

The Danish Ross chicks had a significantly higher prevalence of impaired walking ability and TD than the Swedish Ross chicks. The Danish chicks, however, had a significantly lower prevalence of VV than both the Swedish Ross and the Swedish Cobb chicks. The Danish and the Swedish Ross chicks showed different relationships between body weight and probabilities of impaired walking ability (gait score > 2), TD and VV. For TD and VV, the increase in probability with increasing body weight was slower in Danish than in Swedish chicks. This indicates that the differences in prevalence of gait score > 2, TD and

https://doi.org/10.1017/S0962728600026361 Published online by Cambridge University Press

VV were due to differences in mean body weight as well as management factors, including housing conditions.

The significantly lower prevalence of FPD in Swedish Cobb chicks than in either Danish or Swedish Ross chicks may be due to better housing conditions for Cobb chicks. The better ventilation and dry litter quality observed in these houses during the survey may have reduced the risk of FPD lesions (Ekstrand *et al* 1998). The inverse relationship between the probability of FPD and body weight found in Cobb chicks is difficult to explain. The chicks are evenly distributed in the house regardless of body weight and are equally exposed to the possible variations in litter quality related to the position of drinkers, fans etc. Therefore, no relationship with body weight is to be expected.

We conclude that the prevalence of leg problems is influenced by body weight as well as housing conditions. However, further studies are required to estimate the influence of different risk factors related to housing and management of the chicks under commercial conditions.

Acknowledgements

The Swedish survey was a carried out as a collaboration between The Swedish University of Agricultural Sciences, Faculty of Veterinary Medicine, Department of Animal Environment and Health, Skara, Sweden; and The Royal Veterinary and Agricultural University, Department of Animal Science and Animal Health, Section of Ethology, Copenhagen, Denmark. The project was financed by The Swedish Boards of Agriculture and The Swedish Poultry Meat Association. The Danish survey was supported by a grant to Gurbakhsh Singh Sanotra by The Danish Poultry Council and The Danish Animal Welfare Society.

References

Anon 2000 *The welfare of chickens kept for meat production (broilers)*. Report of the Scientific Committee on Animal Health and Animal Welfare. European Commission, Health and Consumer Protection Directorate-General: Brussels, Belgium

Berg C and Sanotra G S 2001 Kartlaggning av forekomsten av benfel hos svenska slaktkycklingar — en pilotstudie. *Svensk Veterinartidning 53*: 5-13 [Title translation: A survey of the prevalence of leg weakness in Swedish broiler chickens — a pilot study]

Butterworth A, Weeks C A, Crea P R and Kestin S C 2002 Dehydration and lameness in a broiler flock. *Animal Welfare 11*: 89-94

Danbury T C, Weeks C A, Chambers J P, Waterman-Pearson A E and Kestin S C 2000 Self-selection of the analgesic drug carprofen by lame broiler chickens. *Veterinary Record 146*: 307-311

Ekstrand C, Carpenter T E, Andersson I and Algers B 1998 Prevalence and control of foot-pad dermatitis in broilers in Sweden. *British Poultry Science 39*: 318-324

Julian R J 1984 Valgus-varus deformity of the intertarsal joint in broiler chickens. *Canadian Veterinary Journal 25*: 254-258

Kestin S C, Knowles T G, Tinch A E and Gregory N G 1992 Prevalence of leg weakness in broiler chickens and its relationship with genotype. *Veterinary Record 131*: 190-194

Kestin S C, Su G and Sørensen P 1999 Different commercial broiler crosses have different susceptibilities to leg weakness. *Poultry Science 78*: 1085-1090

Lynch M, Thorp B H and Whitehead C C 1992 Avian tibial dyschondroplasia as a cause of bone deformity. *Avian Pathology 21*: 275-285

McGeown D, Danbury T C, Waterman-Pearson A E and Kestin S C 1999 Effect of carprofen on lameness in broiler chickens. *The Veterinary Record 144*: 668-671

McNamee P T, King D C, Spratt-Davidson S, Ball H and Smyth J 2000 Guidelines for the investigation of lameness in commercial broiler fowl. *Irish Veterinary Journal 53(4)*: 191-194

Rath N C, Huf W E, Ayyari G R and Balog J M 1998 Cell death in avian tibial dyschondroplasia. *Avian Diseases 42*: 72-79

Sanotra G S 1999 Registering af aktuel benstyrke hos slagtekyllinger (Velfærdsmoniteringsprojekt). Report from the Danish Welfare Council: Copenhagen, Denmark [Title translation: Leg problems in broilers: a survey of conventional production systems in Denmark]

Sanotra G S, Lund J D, Ersbøll A K, Petersen J S and Vestergaard K S 2001 Monitoring leg problems in broilers: a survey of commercial broiler production in Denmark. *World's Poultry Science Journal 57*: 55-69

SAS Institute 1990 *SAS Stat User's Guide, Version 6, Edn 4.* SAS Institute Inc: Cary, NC, USA

Vestergaard K S and Sanotra G S 1999 Relationship between leg disorders and changes in the behaviour of broiler chickens. *Veterinary Record 144*: 205-209

Weeks C A, Danbury T D, Davies P H and Kestin S C 2000 The behaviour of broiler chickens and its modification by lameness. *Applied Animal Behaviour Science 67*: 111-125

Yalcin S, Settar P and Dicle O 1998 Influence of dietary protein and sex on walking ability and bone parameters of broilers. *British Poultry Science 39*: 251-256