# The Incidences of Leg and Foot Abnormalities in Wrolstad White Turkeys

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*ABSTRACT* The leg and foot abnormalities of a flock of 911 Wrolstad White turkeys were described and were analyzed statistically to determine the relationship of the incidences of leg and foot abnormalities to sex and body weight of the turkeys. Body weight and a visual observation of the condition of legs and feet of each turkey were recorded at the age of nearly 12 weeks. The sex of each turkey had been recorded at one day of age.

Based on chi-square contingency tables, the incidence of the leg and foot abnormalities was related to sex. The male turkeys were far more likely to experience leg and foot abnormalities than were the females. The incidence rate of severe leg and foot abnormalities was 16.1% for the males and 4.8% for females. The incidence of leg and foot abnormalities was not related to weight per se. The light turkeys of either sex were just as likely as the heavy turkeys of the same sex to have leg and foot abnormalities.

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## INTRODUCTION

ABNORMALITIES of the legs and feet of growing turkeys have been a major problem in the turkey industry. This problem has been reviewed by Norris (1970). Leg weakness of poultry has been characterized clinically and pathologically by Nairn and Watson (1972).

This report describes the abnormalities observed in Wrolstad White turkeys and correlates the incidence with regard to sex and body weight.

## PROCEDURE

Two flocks of turkeys, both received from the same hatch, were raised in separate pens in a turkey research building. Each flock initially consisted of 532 turkeys, half male and half female. Both flocks received the same feed formula and essentially the same management. The litter in both rooms was one inch of peanut hulls placed on top of the concrete floor when the poults were placed in the room. No additional litter was added except occasionally around the drinking areas.

Each turkey was identified with a numbered wing-band when it was one day old. At this time, the weight and sex of each turkey was recorded. Each turkey in Pen #3 was weighed at five days of age and every week thereafter until the age of 82 days. At six days of age and every week thereafter until the age of 83 days each turkey in Pen #1 was weighed. At the last weighing of each flock, a visual observation of the lesions of the legs and feet of each turkey was recorded.

Each turkey was also given a classification of 1, 2, or 3 based on the condition of the legs and feet. A classification of 1 corresponded to a condition of no apparent leg or foot weaknesses or deformities. Those turkeys exhibiting some leg or foot abnormalities were given a classification of 2, while those turkeys with severe leg or foot abnormalities were given a classification of 3. The turkeys that were classified 2 exhibited some deformities, but they were still able to walk quite well. The turkeys given a classification

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of 3 were very crippled and had difficulty in walking and in balancing themselves. Of the total of 911 turkeys observed, only three were so severely crippled that they were emaciated, apparently because they were unable to move to the feeder. It must be pointed out, however, that several other crippled birds were either emaciated or trampled to death before our observations were recorded.

## RESULTS AND DISCUSSION

The lesions of the legs and feet were first observed at an age of about 6 to 8 weeks in a few turkeys. These lesions gradually progressed to affect more turkeys and to affect them more severely. The three predominant lesions observed were: 1) deviated toes, 2) sickled-hocks, and 3) twisted tibia. Some of the severely crippled turkeys exhibited combinations of the above three lesions. Of the turkeys with the deviated toes, one or both feet were affected. In some cases only the center toe was curved while in more severe cases, all of the toes were curved. Figure 1 is a close-up view of a turkey foot with deviated toes. The turkeys with the sickled-hocks generally were affected in both legs. Several of the turkeys were so severely sickle-hocked that when they moved, the tarso-metatarsus bones were essentially parallel with the floor. Figure 2 is a view of a severely crippled bird with both sickled-hocks and deviated toes. The incidence rate of twisted tibia as described by Laursen-Jones (1968) and Nairn and Watson (1972) were observed to be very low. There is little indication that osteomyelitis (Nairn, 1969), osteodystrophy (McCapes, 1967) or other forms of leg and foot weaknesses were present in these flocks.

The majority of the lesions observed correspond closely to the description given by Swarbrick (1966). His report described lesions which first became apparent at 10 to 11 weeks of age and became progressively worse until examined at 13 weeks. He also indicated that the condition had earlier been reported to have occurred in 8 to 10 week old turkeys. The lesions were associated with the faster growing turkeys and had caused no apparent clinical problems.

To determine statistically the relationship between the incidence of leg and foot abnormalities, chi-square contingency tables were utilized. Initially, it was desired to test the null hypothesis that the incidence of leg and foot abnormalities was uniformly distributed over all weights of turkeys. The weights of the 911 turkeys were arbitrarily placed in

FIG. 1. Close-up view of a turkey foot with deviated toes.

FIG. 2. A severely crippled turkey with both sickled hocks and deviated toes.

three weight categories of: 1) light, 2) medium and 3) heavy. The weight limits to establish the three categories of weight were selected so that there was an approximately equal number of turkeys in each weight category. Before establishing the weight categories, it was first necessary to estimate the weight of each turkey in Pen #1 at the age of 82 days when the turkeys in Pen #3 were weighed. This estimation was done by linearly interpolating between the weights at 83 days and 76 days to estimate the weight of each turkey in Pen #1 at 82 days of age.

After the linear interpolation was completed, the null hypothesis that the incidence of leg and foot weaknesses was uniformly distributed over all three weight categories was tested using a 3 × 3 contingency table, presented in Table 1. The expected values, enclosed in parentheses in all the contingency tables in this publication, were calculated according to Steel and Torrie (1960). The calculated value of chi-square was 40.04. The tabulated value of chi-square for 4 degrees of freedom and a 5% probability level is 9.49. The null hypothesis was rejected. Clearly, a direct relationship existed between body weight of the turkeys and the incidence of leg and foot weaknesses.

Next the null hypothesis that leg and foot abnormalities were uniformly distributed between both the males and females was tested using a 3 × 2 contingency table. The results are presented in Table 2. The calculated value of chi-square was 61.66. The tabulated value of chi-square for 2 df at 5% probability level is 5.99. Again the null hypothesis was rejected. The interpretation is that the male turkeys were far more likely to have leg and foot abnormalities than were the females.

From the contingency table in Table 2, one can easily calculate that 68.0% of the male turkeys had no apparent leg or foot abnormalities while 89.1% of the females were in this category. Under the category of some leg and foot abnormalities were 15.9% of the males and 6.1% of the females. Of all the males, 16.1% exhibited severe leg or foot abnormalities while the figure for females was 4.8%.

The null hypotheses that leg and foot abnormalities were uniformly distributed over the three weight categories of male and female turkeys separately were tested. The contingency table for males is presented in Table 3; for females, Table 4. The calculated value

TABLE 1.—*Contingency table for test of interaction between abnormalities of legs and feet and body weight of Wrolstad White turkeys (Expected values are enclosed in parentheses.)*

| Abnormalities of legs and feet | Weight | | | Totals |
|---|---|---|---|---|
| | Light | Medium | Heavy | |
| None | 255(241.8) | 267(245.0) | 198(233.2) | 720(720.0) |
| Some | 30 (32.9) | 18 (33.4) | 50 (31.7) | 98 (98.0) |
| Severe | 21 (31.2) | 25 (31.6) | 47 (30.1) | 93 (92.9) |
| Totals | 306(305.9) | 310(310.0) | 295(295.0) | 911(910.9) |

TABLE 2.—*Contingency table for test of interaction between abnormalities of legs and feet and sex of Wrolstad White turkeys*

| Abnormalities of legs and feet | Sex | | Totals |
|---|---|---|---|
| | Male | Female | |
| None | 295(343.0) | 425(377.0) | 720(720.0) |
| Some | 69 (46.7) | 29 (51.3) | 98 (98.0) |
| Severe | 70 (44.3) | 23 (48.7) | 93 (93.0) |
| Totals | 434(434.0) | 477(477.0) | 911(911.0) |

TABLE 3.—*Contingency table for test of interaction between abnormalities of legs and feet and body weight of male Wrolstad White turkeys*

| Abnormalities of legs and feet | Weight | | | Totals |
|---|---|---|---|---|
| | Light | Medium | Heavy | |
| None | 102 (96.5) | 96 (96.5) | 97(102.0) | 295(295.0) |
| Some | 18 (22.6) | 25 (22.6) | 26 (23.8) | 69 (69.0) |
| Severe | 22 (22.9) | 21 (22.9) | 27 (24.2) | 70 (70.0) |
| Totals | 142(142.0) | 142(142.0) | 150(150.0) | 434(434.0) |

TABLE 4.—*Contingency table for test of interaction between abnormalities of legs and feet and body weight of female Wrolstad White turkeys*

| Abnormalities of legs and feet | Weight | | | Totals |
|---|---|---|---|---|
| | Light | Medium | Heavy | |
| None | 141(141.7) | 143(145.2) | 141(138.1) | 425(425.0) |
| Some | 9 (9.7) | 13 (9.9) | 7 (9.4) | 29 (29.0) |
| Severe | 9 (7.7) | 7 (7.9) | 7 (7.5) | 23 (23.1) |
| Totals | 159(159.1) | 163(163.0) | 155(155.0) | 477(477.1) |

TABLE 5.—*Contingency table for test of interaction between sex and body weight of Wrolstad White turkeys*

| Sex | Weight | | | Totals |
|---|---|---|---|---|
| | Light | Medium | Heavy | |
| Male | 37(145.8) | 109(147.7) | 288(140.5) | 434(434.0) |
| Female | 269(160.2) | 201(162.3) | 7(154.5) | 477(477.0) |
| Totals | 306(306.0) | 310(310.0) | 295(295.0) | 911(911.0) |

of chi-square for the male turkeys was 2.46; the value for the females was 2.09. For the males and for the females, each null hypothesis was accepted. The interpretation of accepting both null hypotheses is that the light-weight birds of either sex were just as likely to be afflicted with leg and foot abnormalities as were the medium-weight or the heavy-weight birds of the same sex.

At first glance there may appear to be a conflict between the conclusions based on the results in Table 1 and those in Tables 3 and 4. The results in Table 1 verify that heavy turkeys are more likely to have leg and foot abnormalities than light turkeys, while the results in Tables 3 and 4 verify that the incidence of leg and foot abnormalities is independent of weight for each sex of turkeys.

To show the interaction between sex of the turkeys and body weight, a $2 \times 3$ contingency table was used. The null hypothesis tested was that the body weights of the turkeys were independent of sex. The results are presented in Table 5. The calculated value of chi-square was 470.12, clearly indicating that the body weights were not independent of sex.

When one considers that the male turkeys weighed, on the average, 29.6% more than the females, then it should be apparent that there is no contradiction in the conclusions from the various contingency tables.

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# An Evaluation of Interior Quality of Shell Eggs Packed in the Carton While Still Warm[1]

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*ABSTRACT* The interior quality of warm shell eggs packed in cartons was compared with that of eggs pre-cooled prior to cartoning. Five carton types were used for a two-week refrigerated storage period. After two weeks, there was no difference in weight loss between the two methods of packing. Eggs packed in molded pulp cartons lost more weight than those packed in plastic foam cartons. There was no difference in interior quality between pre-cooled and warm cartoned eggs after two weeks of refrigerated storage.

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## INTRODUCTION

MODERN egg handling equipment and systems are making it possible to deliver shell eggs to the consumer much faster than in past years. Also with the advent of in-line production-processing equipment, the practice of pre-cooling eggs prior to cartoning becomes more expensive.

The cooling of eggs prior to packing as practiced on farms for many years was a simple procedure when eggs were hand gathered from nests or from cage rows and immediately placed in the cooler. Overnight cooling aided in quality retention, better blood spot detection and assisted in the work organization of the farm. However, with in-line equipment, the pre-cooling of eggs prior to packing requires the extra handling associated with removing, cooling and returning the eggs to the system or the construction of in-line cooling tunnels. Either operation may add more to cost than is gained by the efficiency of this in-line system.

Warm packing of eggs has never been a recommended procedure. However, Bauermann *et al.* (1969) reported no deleterious effects on quality when tray packed eggs were cased warm. Lentz and Fletcher (1968), however, have shown that cartoned eggs cased and packed on pallets may take as long as 10 to 14 days to cool to 12° C. from a 24° C. temperature after leaving the washer. Excessive heat has always been known to be detrimental to egg quality. However, Vadehra *et al.* (1969) reported that a dry heat pasteurization (60° C. for four hours) assisted

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