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Evaluation of Mortality in Selected Body Weight Lines of Japanese Quail Using Survival Analysis

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Abstract: Quail raising has become an important poultry business in the world. The objective of this study was to carry out survival analysis to evaluate and quantify risk factors involved in mortality of Japanese quail. Survival analysis and Cox proportional hazards model used to describe mortality in Japanese quail with hatch weight and post hatch body weight as a risk factors. Weight is a variable change with time, so it considered time dependent covariate. Survival function distribution and Kaplain Meier curve showed that mortality was higher in the line selected for high compared to low and control line. Log- rank test used for testing equality of survival distributions for the different levels of selected lines (Log-Rank value = 9.898) resulted P value = 0.007 which is a highly significant. Mortality declined when posthatch body weight increased. Body weight at hatch did not significantly affect mortality. However, posthatch body weight (BW) affects mortality significantly with P- value (0.011) and hazard ratio (1.009). Any factors affect growth after hatching may likely have a direct impact on mortality. Deficiency of water, feed, warmth and potential negative social interaction are factors that could affect mortality immediately after hatch. Through survival analysis, the present study has revealed that factors affecting post hatch Body weight negatively are likely risk factors for mortality in growing birds.

Key words: Mortality · Survival Analysis · Japanese quail · Cox Regression Model · Hazard Ratio (HR)

INTRODUCTION

Quails are stronger under harsh environmental conditions compared to other poultry animals. Quails are very sensitive to small-scale environmental changes during hatching period. Death rates increase due to such sensitivity [1]. Many factors can interfere with success of survive and the quality of hatched chicks, such as critical period from 8 to 15 days of age, loss genetic fitness resulting from selective breeding of animals in hatchery-type operations [2], biochemical genetics of birds, the breeding, rearing, transport of birds and failure to recognize natural food [3].

Survival analysis is a set of statistical methods for examining not only event occurrence but also the timing of events. These methods developed for studying death, hence the name survival analysis and used extensively for that purpose [4]. Quantifying of risk factors by survival analysis (Cox model) is widely applied in many fields such as biology, medicine, public health and epidemiology. A typical analysis of survival data involves the modeling of time-to-event data, such as the time until death [5]. Because animal health and welfare, sustainable breeding and more balanced selection objectives are progressively playing a more central role in animal breeding, there is definite need for better statistical tools to access the genetic components of fitness in domestic animals. Therefore, there is no doubt that survival analysis will take a more prominent place among animal breeders, not only cattle breeding but also in other species [6]. Data collected from animal studies often censored because the study may end before the event observed or because an animal eliminated from the study for reasons other than the defined event. Observations made on such individuals called censored. A censored or incomplete observation occurs when an individual did not achieve the event of interest during the study period [7]. Although classical theory of linear regression and least squares estimation does not extend to data with censored observations, survival analysis techniques can accommodate censoring

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and permit the estimation of treatment effect adjusted for covariates [8]. Survival analysis permits the use of censored and uncensored data. Among the frequently used survival models is a proportional hazard model, which is also known as a Cox regression [9]. The Cox model is a semi-parametric procedure that does not require the choice of a particular probability distribution to represent survival times. This model also makes it relatively easy to incorporate time-dependent-covariates, that is, covariates that may change in value over the course of the observation period. The objective of the current study was to conduct survival analysis, using Cox's proportional hazard regression model, to evaluate risk factors with occurrence of mortality in divergently selected lines and controls of Japanese quail.

MATERIALS AND METHODS

This study was conducted at the poultry Farm, Faculty of Veterinary Medicine, Zagazig University. Japanese quail birds, 2ndweek of age were wing banded for the experimental work. The birds were collected from experimental unit in Faculty of Agriculture, Zagazig University.

Birds and the Experimental Design: Selection procedures based on the individual body weight at four weeks of age. Three lines of Japanese quails were selected from the base population including high body weight, low body weight and random bred control. Selection procedures have not changed at any time during the experiment. Each female was mated to a single male and mating between half sibs and/or more closely related individuals were avoided. After hatching until the end of brooding period (Fourth week of age), chicks identified using wing bands according to their families and sex was determined at 4th week of age and were brooded at the floor. At seven weeks of age the selected birds (High and low body weight line) were kept in cages (25x 25x30cm) using one male to one female in one cage forming a sire family, (Single pair mating) [10]. Chicks were brooded at the floor. The temperature was 37.5°C at the first week after hatching and decreased 2-3°C weekly until reached to 26-28°C which continues until the end of brooding period (Fourth weeks)[11]. The vaccination and/or beak trimming programs had not been done to the breeding stocks. 24 hrs of continues daily light program was allowed during brooding period until the six weeks of age and then reduced to 14hs light: 10hs dark. Commercial quail's diet containing (24% protein and 2975.8 K.cal ME/kg) was fed ad libitum throughout the experimental period. Hatch weights and post hatch weights data were collected on all birds, as well as body weight at the time of death for birds that died before 56 day of age. Mortality in the present study (The event of interest) was defined as the time from hatch to the date the bird died. Data were considered complete (Uncensored) if the quail died for any reason before56day of age. Censored data, therefore, represented quail that were still alive on day 56 when quail reached mature Body weight.

Statistical Analysis: Statisticians have devised various methods to deal with censored data, which includes complete data analysis [12]. The more effective methods that are widely used in survival studies encountering censored data are likelihood-based approaches (Survival analysis methods) which adjust for the occurrence of censoring in each observation and thus are advantageous that it uses all available information [13]. Survival analysis techniques used for dealing with censored data can be broadly classified into nonparametric (Kaplan Meier product limit method) [14], parametric (Weibull and exponential methods) and semi-parametric method (Cox-proportional hazards method) [15]. The latter two can also applied as regression-based models.

The Kaplan–Meier method can used to estimate the survival curve from the observed survival times without the assumption of an underlying probability distribution. The proportion surviving period i having survived up to period i is given by:

$$p_i = \frac{r_i - d_i}{r_i}$$

Where: r_i is the number alive at the beginning of the period and d_i the number of deaths within the period.

Comparison of two or more survival curves can done using a statistical hypothesis test called the log rank test. The test statistic is calculated as follows:

$$\chi^2(\log rank) = \frac{(O_1 - E_1)^2}{E_1} + \frac{(O_2 - E_2)^2}{E_2}$$

Where the O_1 and O_2 are the total numbers of observed events in groups 1 and 2, respectively and E_1 and E_2 the total numbers of expected events.

Cox proportional hazard model used to quantify the effect of each of the explanatory variables on mortality (hatch weight and body weight at death were used as covariates in the model).

Survival analysis or Cox proportional hazard model is a statistical method for studying the occurrence and timing of events, where the outcome variable corresponds to a measure of time elapsed from a starting point until the occurrence of certain event [16]. The length of this interval is not always known, because competing events may occur before the occurrence of the event under study.

$$h(t,x) = h_0(t) \exp\{\beta_1 X_1 + \ldots + \beta_k X_k\}.$$

Where
$h(t; x)$ is the hazard function at time t for a subject with covariate values $x_1, \ldots x_k$.
$h_0(t)$ is the baseline hazard function, i.e., the hazard function when all covariates equal zero.
exp is the exponential function ($\exp(x)= e^x$).
x_i is the i^{th} covariate (explanatory/predictor variables) in the model.
β_i is the regression coefficient for the i^{th} covariate, x_i.

For quantitative covariates (e.g., hatch weight and body weight at death), subtracting 1.0 from hazard ratio (HR) and multiplying by 100 gives the estimated percentage change in the hazard for each unit increase in the covariate. SPSS/ PCT system package was used to determine the baseline hazard function and to model the effects of hatch weight and body weight at death as risk factors [17]. Two chi-squared statistics (Likelihood ratio and Wald test) were used to test for the signi?cance of the overall model and for the risk factors (i.e., hatch weight and body weight at death on time of death).

RESULTS

The Kaplan-Meier estimate of the survival function was presented in the Kaplan-Meier curve as in Figure (1). The number of censored and complete data with their percent of each one was described in Table (1).

Comparing survival functions of the three lines as in Table (2).

Weight is considered a variable change with time, so the extended Cox model (Time dependent covariate) was used and its results in Table 4.

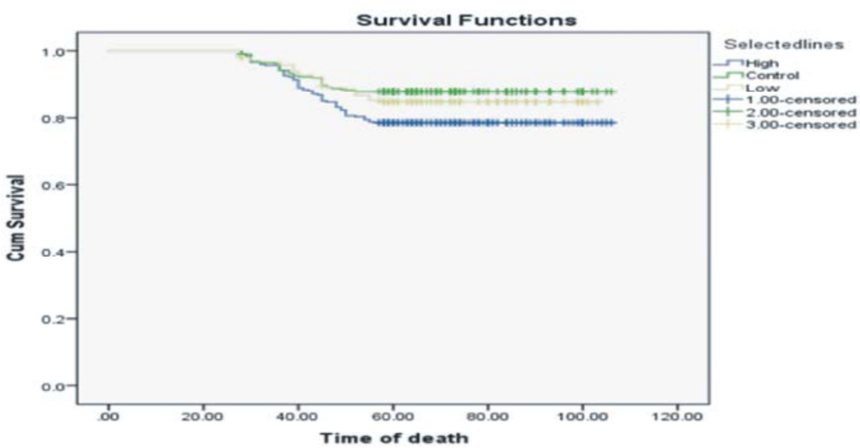

Fig. 1: Survival curves in the three experimental Japanese quail selected lines. High = selected for high 4-wk BW; Control = unselected; Low = selected for low 4-wk BW.

Table 1: The number of censored and uncensored birds in three experimental Japanese quail selected lines

Selected Lines	Total No.	Percent	No. of events (Died birds)	Censored (Live birds) N	Percent
High	327	38.33%	70	257	78.6%
Control	313	36.7%	38	257	87.9%
Low	213	24.97%	32	181	85%
Overall	853	100%	140	713	83.6%

Table 2: Test of equality of survival distributions for the different levels of selected lines

	Chi-Square	d.f	Sig.
Log- Rank (Mantel-Cox)	9.898	2	0.007

The result of log likelihood chi-square of overall model was 1855.886 showed P value = 0.011*.

Table 3: Cox proportional hazard regression of mortality in Japanese quail

Risk factor	β	S.E	Wald(β/ S.E)^2	Sig.	Exp(β) (hazard ratio)
Hatch weight	0.077	0.087	0.775	0.379^{ns}	1.080
Body weight at death	0.009	0.004	5.860	0.015*	1.009

h(t| x) = h(t|0) * exp (0.077 *hatch weight + 0.009 * BW at death)

Table 4: Results of the extended Cox model of mortality in Japanese quail

Risk factor	β	S.E	Wald (β/ S.E)^2	p-value	Exp(β) (hazard ratio)
Time-dependent-covariates	0.001	0.000	6.528	0.011	1.001
Body weight at death	-0.033-	0.017	3.741	0.053	0.967

DISCUSSION

The number of censored and uncensored birds for each line used in the analysis showed the estimated baseline survivor function (h_0 (t)) for all birds in the analysis was shown in Table 1and Figure 1. Baseline survivor function is a fraction of birds that will still be a live t days after hatch if mortality was not in fluenced by hatch weight and posthatch body weight. There was significant difference between selected lines (High, control and low) since Cox-Mantel test (Log-Rank value = 9.898) resulted P value = 0.007** which is a highly significant as in Table 2.

Cox model results showed a significant difference, so the covariates have a significant effect on the probability of mortality (Hazard rate). Body weight at hatch did not significant-affected mortality as P-value 0.379. However, posthatch Body weight significant-affected mortality as P-value 0.015as in Table (3).The hazard of mortality at hatch weight was (1.08) indicated a great chance of mortality. When the age increased the chance of mortality declined as the hazard of mortality for post hatch body weight was (1.009) these findings agreed with Aggrey and Marks [18].The time-dependent covariate has a significance value less than 0.05, which means it contributes to the model. It was found that the effect of weight on mortality is time-dependent and added a term to the model that helped to account for that dependence.

CONCLUSION

Survival analysis was used as statistical methods for evaluation of mortality and for some risk factors that affect mortality in Japanese quail, as it was easily to deal with censored data. It concluded that, through survival analysis proved that, the different lines of Japanese quail are different in mortality and the chance of mortality declined when Body weight increased. From extended Cox model weight changed with time and the probability of mortality also changed with time.

REFERENCES

1. AtillaTaskin and UfukKaradavut, 2014. Analysis of postnatal mortality in quails through conditional and limited logistic regression. Research Journal of Agriculture and Environmental Management., 3(1): 068-073.
2. Temple, S.A., 1977. Genetic aspects of managing dwindling bird populations. Pages 274-320 in Endangered birds; management techniques for preserving threatened species. University of Wisconsin Press, Madison, pp: 466.
3. Mabie, D., 1980. Evaluate pheasant release techniques. Fedral Aid Proj. W-108-R-3. Job14. Final Report, pp: 6.
4. Williams, C.S., 2008. Surviving survival analysis – An applied introduction. NESUG (North East SAS User Group Conference).
5. Zhao, G.M.A., 2008. Nonparametric and parametric survival analysis of censored data with possible violation of method assumptions. Published Master Thesis. Faculty of TheGraduateSchool at the University of North Carolina at Greensboro.
6. Gurcan, I.S. and A. Akcay, 2007. Survival analysis on calving interval and gestation length in Simmental x South Anatolian Red F_1 X B_1 crossbred cows. Ankara, Üniv. Vet. Fak. Derg., 54: 219-222.

7. Lee, E.T., 1992. Introduction-censored observation. In Statistical methods for survival data analysis, probability and mathematical statistics. Wiley, New York, pp: 1-7.
8. Marubini, E. and M.G. Valsecchi, 1995. Analysing survival data from clinical trials and observational studies. John Wiley and Sons. New York.
9. Cox, D.R., 1972. Regression models and life-tables (With discussion). Journal of the Royal Statistical Society Series, 34: 187-220.
10. Becker, 1985. Manual of procedures in quantitative genetics. Vash. State, Press. Palma, Washington.
11. Randall, M. and G. Bolla, 2008. Raising Japanese quail. Prime fact., 602, second edition, pp: 1-5.
12. Leung, K.M., R.M. Elashoff and A.A. Afifi, 1997. Censoring issues in survival analysis. Annu. Rev. Public Health, 18: 83-104.
13. Prinja, S., N. Gupta and R. Verma, 2010. Censoring in clinical trials: Review of survival analysis techniques. Indian J. Community Med., 35(2): 217-21.
14. Kaplan, E.L. and P. Meier, 1958. Nonparametric Estimation from Incomplete Observations. J. Amer. Statist. Assn., 53(282): 457-481.
15. Lee, E.T. and J.W. Wang, 2003. Statistical Methods for Survival Data Analysis. A wiley-Interscience puplication, John Wiley and Sons, Inc. 3rd Ed., Ch., 1,p. 1, Ch. 2,p. 8.
16. Schneider, D.P., M.E. Strandberg, V. Ducroco and A. Roth, 2005. Survival analysis applied to genetic evaluation for female fertility in dairy cattle. J. Dairy Sci., 88: 2253-2259.
17. Foster, J.J., 2001. Data analysis using spss for windows: A beginner's guide (second edition) London Sage.
18. Aggrey, S.E. and H.L. Marks, 2002. Analysis of censored survival data in Japanese quail divergently selected for growth and their control. Poultry Science, 81: 1618-1620.