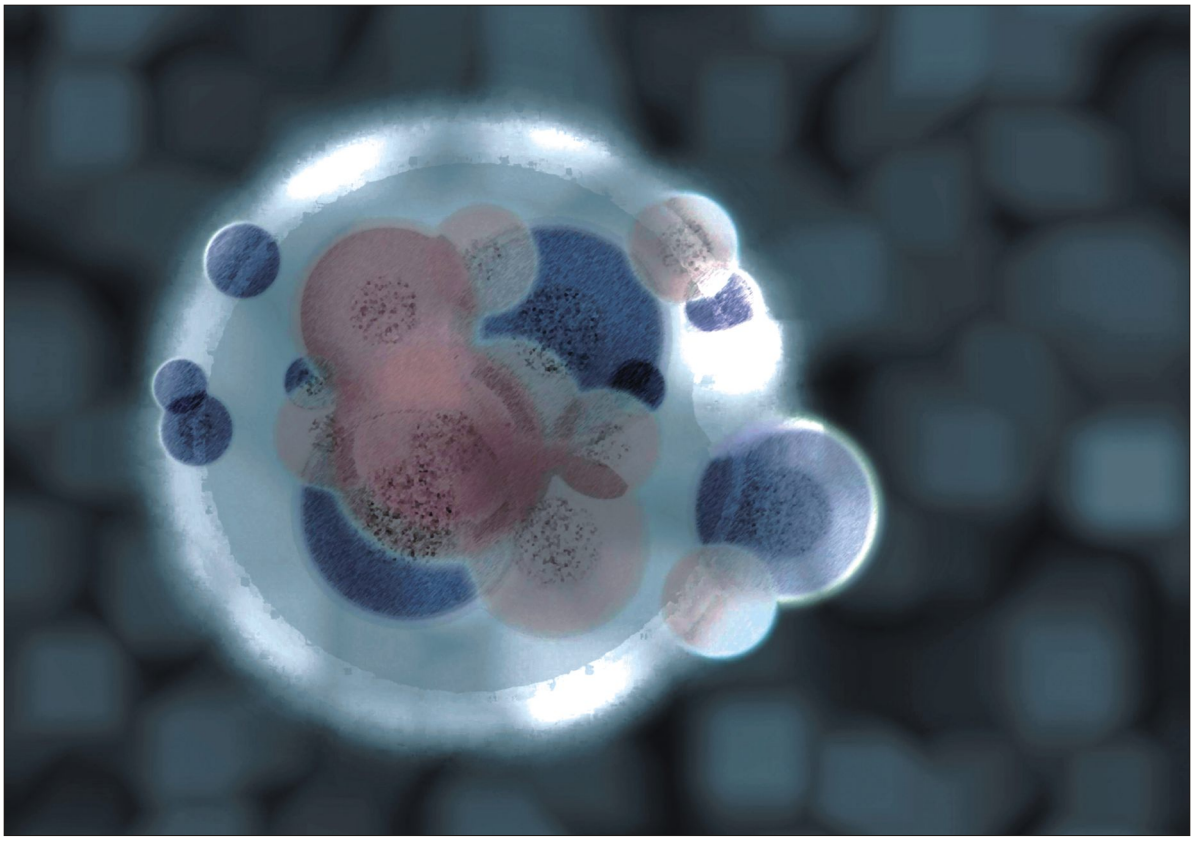

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Prevalence and Economic Ramification of Newcastle Disease in Backyard Chicken in Charsadda, NWFP, Pakistan

[1]C. Naila, [1]M. Farooq, [1]F.R. Durrani, [2]A. Asghar and [3]Pervez
[1]Department of poultry Science, NWFP, Agricultural University, Peshawar, Pakistan
[2]Sarhad Rural support corporation (SRSC), SOU, Haripur, Pakistan [3] VRI, Peshawar, Pakistan

Abstract: Twenty female farmers in each of 20 different villages of district charsadda, NWFP were selected at random to investigate prevalence and economic ramification of Newcastle disease in Backyard chicken. Overall Morbidity and mortality was 31.0 ± 1.84 and 26.98 ± 1.14%, respectively causing 86.95 ± 0.79% mortality among the sick birds. Morbidity (56.93 ± 7.61) and mortality (98.66 ± 7.03%) among the sick birds was higher ($p<0.05$) in White Leghorn (WLH) than in Fayumi (17.94 ± 2.22 and 74.28 ± 1.91), Rhode Island Red (RIR; 27.79 ± 3.73 and 90.67 ± 3.71) and Local chicken (20.82 ± 1.34 and 84.24 ± 0.89%, respectively). Overall mortality was also higher in WLH (49.23 ± 6.92%) than in Fayumi (14.36 ± 1.89%), RIR (24.10 ± 3.36%) and Local (20.18 ± 1.18%) morbidity (49.19 ± 1.56%), mortality among the sick birds (99.89 ± 0.93%) and overall mortality (44.88 ± 1.45%) was higher ($p<0.05$) in those flock which were not vaccinated flocks than in flocks regularly vaccinated (12.84 ± 1.01, 65.96 ± 2.02% and 8.92 ± 0.84%, respectively). Morbidity (46.82 ± 2.35%) and mortality among the sick birds (98.58 ± 0.27%) was higher ($p<0.05$) in chicks than in adult birds (17.63 ± 1.23 and 76.06 ± 1.80%) and pullets (28.92 ± 2.49 and 85.79 ± 0.87%, respectively). Overall mortality was also higher in chicks (40.71 ± 1.52) than in adult birds (15.76 ± 0.91%) and Pullets (24.39 ± 1.07%). Higher morbidity and mortality (among the sick birds) was observed in winter season (72.08 ± 0.84 and 98.82 ± 0.82) than in Summer (29.45 ± 0.78 and 90.93 ± 0.89), Fall (14.63 ± 0.68 and 82.78 ± 1.03) and Spring season (8.28 ± 0.72% and 74.08 ± 1.2%, respectively). Overall mortality was also high in winter (68.7 ± 0.79%) than in Summer (22.34 ± 0.7%), Fall (11.26 ± 0.8%) and Spring (5.65 ± 0.93%). Although, not significant, morbidity and mortality (among the sick birds) was numerically high (32.16 ± 2.01 and 96.43 ± 2.68%) in chicken having no shelter facility than in those which had a night shelter facilities (30.03 ± 1.95 and 77.51 ± 1.79%, respectively). Per cent morbidity had a non-significant association (b = -0.6341 ± 0.085) with per cent reduction in egg production. Per cent morbidity was found significantly ($p<0.05$) and negatively associated with per cent reduction in eggs of RIR (b = -0.2254 ± 0.572) and local chicken (b = -0.14862 ± 0.047). Per household annual reduction in eggs and economic ramification due to reduced egg production, and mortality were 401.06 ± 1.14 eggs and Rs. 902.45 ± 0.56, and Rs. 1343.84 ± 2.8, respectively. Total per household per year economic ramification due to reduction in eggs and mortality resulting from Newcastle disease was Rs. 2246.29 ± 1.19. Per household per cent reduction in egg production and economic ramification due to reduced egg production of Newcastle affected chicken was higher ($p<0.05$) in WLH (154.41 ± 1.14 number and Rs. 347.42 ± 5.34) than in RIR (114.89 number and Rs. 258.5 ± 2.15), local (76.04 ± 1.14 and Rs. 171.09 ± 2.26) and Fayumi (55.75 ± 0.45 and Rs. 125.44 ± 3.88, respectively). Economic ramification as a result of mortality was also higher ($p<0.05$) in WLH (Rs. 457.32 ± 5.91) than in RIR (Rs. 378.39 ± 2.89), local (Rs. 311.62 ± 2.13) and Fayumi (Rs. 196.72 ± 4.33). Economic ramification due to mortality as a result of Newcastle disease was higher ($p<0.05$) in chick (Rs. 1522.49 ± 1.14) than in pullets (Rs. 1325.21 ± 1.01) and adult birds (Rs. 1183.25 ± 1.26). Protection of chicken from extremes of weathers, provision of shelter and timely vaccination were recommended to avoid losses. In addition, rearing RIR, and Fayumi as backyard chicken along with local chicken (non-descript) would also be helpful in avoiding economic ramification in Charsadda.

Key words: Newcastle, reduction in eggs, morbidity, mortality, backyard chicken and economic ramification

Introduction

Newcastle disease is one of the important disease of chicken influencing higher losses (9.35%; Bhatti, 1989). It is a wide spread disease and could effect any type of chicken at any stage of life. The disease is more prevalent in old birds and chicks than newly hatched chicks. Thitisak *et al*. (1989) also reported a poor antibody titer for Newcastle disease in adult birds (90 days and above) than in newly hatched chicks. Newcastle disease now a day is not a problem in commercial chicken production, as appropriate health coverage programs and effective measures are taken against it. However, it is still a big problem in backyard chicken, being more exposed to adverse conditions. These conditions could become more severe during winter season with severe losses being observed December (Saidu *et al*., 1993). It is also reported that 50% and 83.6% losses due to Newcastle disease respectively, in September and November. Newcastle disease needs due attention in backyard chicken also and could be effectively controlled through vaccination (Rehmani and Firdous, 1995). In order to prevent losses in backyard chicken, it is necessary to manage the chicken well and follow a proper immunization program. This will help in preventing severe losses due to Newcastle disease. The present study was an effort to report losses caused by Newcastle disease and pinpoint possible measures for the prevention of Newcastle disease in backyard chicken in district Charsadda.

Materials and Methods

A survey was conducted in 20 different villages of district Charsadda to investigate prevalence of Newcastle disease in Backyard chicken. Twenty female farmers selected at random in each village were interviewed and information regarding flock size, housing, type of chicken, egg production, reduction in eggs due to morbidity, egg and chicken price, health coverage program and morbidity, and mortality caused by Newcastle at various stages of life and in different seasons of the year were collected. The data were analyzed using univariate analysis, GLM (General Linear Model) procedures and multiple regression (Wonnacott and Wonnacott, 1985). Mortality was calculated on overall basis taking in to account flock size and among the sick birds

also. None descript indigenous chickens were designated as local chicken. The term economic ramification was used instead of reduction in gross or cash income because of no capital or negligible investment on backyard chicken. Thus, economic ramification due to Newcastle disease was computed using the following definition.

Economic ramification = Revenues or gross income not generated due to reduction in egg production as a result of morbidity caused by Newcastle disease + Reduction in gross income as a result of mortality in chicken.

To ascertain the effect of age, season, type of bird, health coverage program and housing facility on morbidity caused by Newcastle disease in Backyard chicken, following statistical model was constructed.

$$Y_{ijklmn} = \mu + a_i + ß_j + \tau_k + \infty_l + \phi_m + e_{ijklmn}$$

Where, "Y_{ijklmn}" was n-th observation on percent morbidity caused by Newcastle disease, "μ" the population constant common to all observations, "a_i" = the effect of i-th age group; i = chick, pullet and adult bird, "$ß_j$" the effect of j-the season; j = spring, summer, winter and fall, "τ_k" the effect of K-th type of bird; k = Rhode Island Red (RIR), Desi chicken, Fayumi and White Leghorn (WLH), "∞_l" the effect of l-th vaccination schedule; l = complete vaccination (first vaccine at day-7, second at day-21 and onward vaccination after every three months), irregular vaccination, at the time of the disease onset and no vaccination practice, "ϕ_m" the effect of m-th housing facility; m = no housing facility, night shelter only, proper house and "e_{ijklmn}" the residual term associated with each Y_{ijklmn}, normally, independently and identically distributed with mean zero and variance 1. A similar, model was employed to mortality caused by Newcastle disease in Backyard Chicken in district Charsadda.

The association between per cent morbidity caused by Newcastle disease in Backyard chicken and in different types of birds with per cent reduction in egg production was established using the following model:

$$Y = b_0 + b_i X_i + e_i$$

Where, "Y" was response variable; "b_i" the partial regression coefficients; "X_i" the regressors and "e_i" was the residual term.

The coefficient of multiple determination (R^2) was computed as follows:

$$R^2 = (r_{y\hat{}y})^2$$

Where R^2 was the coefficient of multiple determination and $r_{y\hat{}y}$ was the correlation between predicted and actual values. (Wonnacott and Wonnacott, 1985).

Results and Discussion

Findings pertaining to morbidity, and mortality and economic ramification due to Newcastle disease in Backyard Chicken in district Charsadda are presented under various sections as follows:

Morbidity and Mortality due to Newcastle Disease: Mean overall morbidity was 31.01 ± 1.84% with a coefficient of variation of 83.07%. Alders *et al*. (1994) reported a little higher (36.9%) seroprevalence of Newcastle disease in chicken in Zambia than the present findings. Mortality on overall basis was 26.98 ± 1.14 and was found to be 86.95 ± 0.79% among the sick birds (Table 1). The higher morbidity and mortality caused by Newcastle disease in Backyard chicken could be due to poor management of the birds and poor health and hygienic measures adopted by the farmers. Backyard chickens usually receive no proper attention in terms of housing, feeding and health coverage.

Type of chicken had a significant ($p < 0.01$) effect on both morbidity and mortality caused by Newcastle disease in Backyard Chicken. Morbidity was significantly ($p < 0.05$) higher in WLH (56.93 ± 7.61%) than in RIR (27.79 ± 3.73), Fayumi (17.94 ± 2.22) and Desi Chicken (20.82 ± 1.34; Table 2). Differences in morbidity among RIR, Fayumi and Desi chicken were not significant. Mortality among the sick birds was higher ($p < 0.05$) in WLH (98.66 ± 7.03%) and lower in Fayumi birds (74.28 ± 1.91%). Non-significant differences existed in mortality among Fayumi and Desi chicken. Differences in mortality between Desi and RIR were also not significant. Overall mortality was significantly ($p < 0.05$) higher in WLH (49.23 ± 6.92%) than in RIR (24.10 ± 3.36), Fayumi (14.36 ± 1.89) and Desi Chicken (20.18 ± 1.18%). The findings suggested a higher morbidity and mortality in WLH and RIR than in Fayumi and Desi Chicken. This could be attributed to hardy nature of Fayumi and Desi chicken as these birds have got a strong resistance to adverse conditions and diseases than exotic chicken (RIR and WLH). All exotic chickens are susceptible to infectious diseases. This disease could cause severe losses in such birds if not produced under well-managed hygienic measures.

Vaccination practice had a significant ($p < 0.01$) effect on morbidity and mortality caused by Newcastle disease in Backyard Chicken. Morbidity (49.19 ± 1.56%) and mortality among the sick birds (99.89 ± 0.93%) were significantly ($p < 0.05$) higher in non vaccinated flocks than in those which were produced under a complete vaccination schedule (12.84 ± 1.01 and 65.96 ± 2.02%, respectively; Table 2). Morbidity (37.11 ± 4.5) and mortality among the sick birds (93.88 ± 2.1%) was also higher in birds which were vaccinated at the time of the disease onset than in those which were exposed to an irregular vaccination program (26.1 ± 2.5 and 86.93 ± 1.9%, respectively). Overall mortality was significantly ($p < 0.05$) higher in non vaccinated flocks (44.88 ± 1.45%) than in vaccinated flocks (8.92 ± 0.84%). Similarly, higher mortality was found in birds vaccinated at the time of disease onset (32.83 ± 4.2%) than in those which were vaccinated irregularly (20.69 ± 2.2%; Table 2). Findings of the present study suggested an increased incidence of Newcastle disease in non-vaccinated flocks against Newcastle disease. Rehmani and Firdous (1995) also reported effective control of Newcastle disease in village chicken through vaccination. The 65.96% losses in vaccinated flocks could be attributed to poor handling of vaccines and ineffective use of vaccine for Newcastle disease.

Age of the bird had a significant effect ($p < 0.01$) on morbidity as well as mortality caused by Newcastle disease in Backyard Chicken. Morbidity (46.82 ± 2.35%) and mortality among the sick birds (98.58 ± 0.27%) were significantly ($p < 0.05$) higher in young chicks than in adult birds (17.63 ± 1.23 and 76.60 ± 1.80%) and pullets (28.92 ± 2.49 and 85.79 ± 0.87%, respectively; Table 2). Overall mortality was significantly higher ($p < 0.05$) in chicks (40.71 ± 1.52%) than in Pullets

Table 1: Morbidity, mortality, reduction in egg production and economic ramification due to Newcastle Disease in Backyard Chicken in District Charsadda

Variables	Mean ± SE (%)	CV(%)
Overall Per cent morbidity	31.01 ± 1.84	83.07
Overall Per cent mortality	26.98 ± 1.14	84.11
Percent mortality amongst the sick birds	86.95 ± 0.79	86.02
Reduction in eggs (#)	401.06 ± 1.41	136.8
a) Reduction in gross income due to reduced egg production (Rs.)	902.45 ± 0.56	37.23
b) Reduction in gross income due to mortality (Rs.)	1343.84 ± 2.8	109.2
Total reduction in gross income in rupees (a + b)	2246.29 ± 1.19	88.9

Table 2: Morbidity, mortality among the sick chicken and overall mortality caused by Newcastle Disease in Backyard Chicken in District Charsadda

Type of chicken		Vaccination programs		Season		Age group of the chicken		Housing Facility	
Breed	Mean ± SE(%)	Vaccination	Mean ± SE (%)	Season	Mean ± SE (%)	Category	Mean ± SE (%)	Housing	Mean ± SE (%)
Local	$20.82_{c} \pm 1.34$	Complete	$12.84_{d} \pm 1.0$	Summer	$29.45_{b} \pm 0.8$	Chicks	$46.82_{a} \pm 2.4$	Night shelter	30.03 ± 1.9
	$20.18_{bc} \pm 1.2$	vaccination	$8.92_{d} \pm 0.84$		$22.34_{b} \pm 0.7$		$40.71_{a} \pm 1.5$		25.73 ± 233
	$84.24_{c} \pm 0.89$		$65.96_{c} \pm 2.0$		$90.93_{b} \pm 0.9$		$98.58_{a} \pm 0.3$		77.51 ± 1.8
Fayumi	$17.94_{c} \pm 2.22$	Irregular	$26.1_{c} \pm 2.51$	Winter	$72.08_{a} \pm 0.8$	Pullets	$28.92_{b} \pm 2.5$	No house	32.16 ± 2.0
	$14.36_{c} \pm 1.89$	vaccination	$20.69_{c} \pm 2.2$		$68.7_{a} \pm 0.79$		$24.39_{b} \pm 1.1$		28.22 ± 2.1
	$74.28_{d} \pm 1.91$		$86.93_{d} \pm 1.9$		$98.82_{a} \pm 0.8$		$85.79_{b} \pm 0.9$		96.43 ± 2.7
Rhode	$27.79_{b} \pm 3.73$	Vaccination	$37.11_{b} \pm 4.5$	Fall	$14.63_{c} \pm 0.7$	Adult birds	$17.63_{c} \pm 1.2$		
Island Red	$24.10_{b} \pm 3.36$	at disease	$32.83_{b} \pm 4.2$		$11.26_{c} \pm 0.8$		$15.76_{c} \pm 0.9$		
	$90.67_{b} \pm 3.7$	onset	$93.88_{b} \pm 2.1$		$82.78_{c} \pm 1.0$		$76.60_{c} \pm 1.8$		
White	$56.93_{a} \pm 7.61$	No	$49.19_{a} \pm 1.6$	Spring	$8.28_{d} \pm 0.72$				
Leghorn	$49.23_{a} \pm 6.92$	Vaccination	$44.88_{a} \pm 1.4$		$5.65_{d} \pm 0.93$				
	$98.66_{a} \pm 7.03$		$99.89_{a} \pm 0.9$		$74.08_{d} \pm 1.2$				

Means given for each category in each column are read as follows;
First row = Morbidity Second row = Mortality on the basis of total flock size maintained by a household Third row = Mortality among the birds household
Means with different subscripts are significantly different at $\propto = 0.05$

Table 3: Reduction in egg production and Economic ramification due to mortality caused by Newcastle Disease in Backyard Chicken in District Charsadda

Breed	Per bird reduction in eggs Mean ± SE (#)	Losses due to reduced egg production Mean ± SE (Rs.)	Losses due to mortality Mean ± SE (Rs.)	Age group of the chicken	Reduction in gross income due to Newcastle disease Mean ± SE (Rs.)
Local	$14.89_{c} \pm 1.14$	$29.78_{c} \pm 2.26$	$60.29_{c} \pm 2.1$	Chicks	$1522.94_{a} \pm 1.1$
Fayumi	$10.93_{d} \pm 0.45$	$21.86_{d} \pm 3.88$	$38.06_{d} \pm 4.3$	Pullets	$1325.21_{c} \pm 1.0$
Rhode Island Red	$22.53_{b} \pm 1.05$	$45.06_{b} \pm 2.15$	$73.21_{b} \pm 2.9$	Adults	$1183.25_{b} \pm 1.3$
White Leghorn	$30.28_{a} \pm 1.14$	$60.56_{a} \pm 5.34$	$88.48_{a} \pm 5.9$		

Means with different subscripts are significantly different at $\propto = 0.05$

(24.39 ± 1.07%) and adult birds (15.76 ± 0.91%). Gail (1994) also reported higher mortality in young chicks (90%) than in adult birds (50%). However, Thitisak *et al*. (1989) reported a contrary findings to the present study stating a poor antibody titer for Newcastle disease in adult birds (90 days and above) than in newly hatched chicks. Findings of the present study suggested a severe susceptibility of chicks to Newcastle disease than adult birds or pullets. This could probably be due to poor maternal immunity of chicks acquired from their parents and onward immunization against Newcastle disease. Chicks usually receive immunity against Newcastle and other infectious diseases from the birds and lasts for few days before chicks are vaccinated against Newcastle disease or any other infectious diseases. Thus, chicks should be regularly vaccinated against infectious diseases to develop their immunity against it. In addition, adult birds are to be properly vaccinated to protect them from Newcastle disease and ensure maximum transfer of maternal immunity to the newly hatching chicks as well.

Season had a significant ($p < 0.01$) effect on morbidity and mortality caused by Newcastle disease in Backyard Chicken. Morbidity was significantly ($p < 0.05$) higher (72.08 ± 0.84%) in winter and lower in spring season (8.28 ± 0.72%; Table 2). Differences in morbidity also existed between summer, and fall and summer, and spring seasons of the year. Mortality among sick birds was significantly ($p < 0.05$) higher in winter (98.82 ± 0.82%) than in spring season (74.08 ± 1.2%; Table 2). Overall mortality was also significantly ($p < 0.05$) higher in winter (68.7 ± 10.79%) than in spring season (5.65 ± 0.93%). Saidu *et al*. (1993) also reported severe outbreak of Newcastle disease in relatively cooler months of the year with severe losses in December. It is reported that higher losses (83.6%) due to Newcastle disease in November than in September (50%). The findings suggested an increasing trend in winter and summer seasons than in relatively favorable seasons of the year (fall and spring). Probably, severe winter and summer conditions could have put the birds under more stressful conditions, which could have lowered the disease resistance capabilities of the birds. Backyard chicken are usually more exposed to severe winter and summer conditions because of the poor housing facilities. Night shelter had no significant effect on morbidity as well as mortality caused by Newcastle disease in Backyard Chicken. Although, non significant, morbidity (32.16 ± 2.01%) and mortality among the sick birds (96.43 ± 2.68%) were numerically high in those chicken which didn't receive any house facility than in those which were provided housing facilities (30.03 ± 1.95 morbidity and 77.51 ± 1.79% mortality; Table 2). The relatively higher losses in chicken receiving no housing facilities could probably be due to the adverse conditions, the chicken were exposed to. The adverse conditions might have lowered the disease resistance capabilities of chicken.

Reduction in Eggs and Economic Ramification Due to Newcastle Disease: Mean per household annual reduction in eggs due to morbidity caused by Newcastle disease was 401.06 ± 1.41 number, resulting in economic ramification of

Rs. 902.45 ± 0.56 (Table 1). Per household per annum economic ramification due to mortality caused by Newcastle disease in Backyard chicken was Rs.1343.84 ± 2.8. Total economic ramification due to Newcastle disease in term of reduced egg production and mortality was Rs. 2246.29 ± 1.19. The findings suggested a higher amount of rupees lost due to Newcastle disease in backyard chicken. This needs to be reduced through better immunization of the backyard chicken to reduce losses. Per cent morbidity also had a relatively significant ($p < 0.09$) and negative association with per cent reduction in eggs ($b = -0.6341 \pm 0.085$). The findings suggested that holding other regressors constant, one per cent increase in morbidity would result a reduction of 0.6341 number of eggs per household per annum.

Mean per household per cent reduction in egg production due to morbidity caused by Newcastle disease was significantly ($p < 0.05$) higher in WLH (30.28 ± 1.14%) and lower in Fayumi chicken (10.93 ± 0.45%). Similarly, reduction in eggs was found to be higher in RIR (22.53 ± 1.05%) than in Desi chicken (14.89 ± 1.14%; Table 3). Per cent morbidity was found significantly ($p < 0.05$) and negatively associated with per cent reduction in egg production of RIR ($b = -0.2254 \pm 0.572$) and Desi chicken ($b = -0.14862 \pm 0.047$). Holding other regressors constant, one per cent increase in morbidity due to Newcastle disease in RIR and Desi chicken will reduce per household per annum egg production by 0.2254 and 0.15 number of eggs. Economic ramification due to reduced egg production in Newcastle affected chicken was higher ($p < 0.05$) in WLH (Rs. 347.42 ± 5.34) than in RIR (Rs.258.5 ± 2.15), Desi (Rs. 171.09 ± 2.26) and Fayumi (Rs. 125.44 ± 3.88; Table 3). Similarly, economic ramification due to mortality caused by Newcastle disease in various type of birds was significantly higher ($p < 0.05$) in WLH (Rs. 457.32 ± 5.91) than in RIR (Rs. 378.39 ± 2.89), Desi (Rs. 311.62 ± 2.13) and Fayumi (Rs. 196.72 ± 4.33; Table 3). The findings suggested a relatively poor performance of WLH than RIR, Desi and Fayumi chicken, Probably Desi, Fayumi and RIR chicken have got a better resistance to Newcastle diseases and other adverse conditions than WLH. Thus, morbidity might have affected egg production performance of WLH badly than any other chicken. Economic ramification due to mortality as a result of Newcastle disease was significantly higher ($p < 0.05$) in chicks (Rs. 1522.49 ± 1.14) than in pullets (Rs. 1325.21 ± 1.01) and adult birds (Rs.1183.25 ± 1.26). The higher economic ramification due to Newcastle diseases in young chicks could probably be due to huge mortality (98.58 ± 0.27) in chicken than in pullets and adult birds. Because, the value of one alive chick was Rs.21.49 which was comparatively smaller than the average prevalent price of a pullet (Rs.76.89) and adult bird (Rs.112.23) in district Charsadda. The smaller price or value in rupees of chick may not be a resultant cause of larger economic ramification of a household if mortality could be reduced in chicks than pullets or adults. In general care must be exercised to prevent losses due to Newcastle disease at any stage of life for making backyard chick productivity more profitable.

Overall morbidity and mortality caused by Newcastle disease in Backyard chicken was higher than the reported values. Following conclusions were extracted from the study.

a) Following complete vaccination schedule, significantly reduced morbidity and mortality in Backyard chicken.
b) Newcastle disease was most prevalent in chicks than in pullets and adult birds. Adult birds were least affected by Newcastle disease.
c) Morbidity and mortality due to Newcastle disease were maximum in winter than in other seasons.
d) Incidence of Newcastle disease was higher in exotic breeds of chicken reared as Backyard chicken. Among the exotic chicken Fayumi and RIR were relatively more resistant to Newcastle disease.
e) Newcastle disease reflected a higher per household per annum reduction in egg production (401.06) and an overall economic ramification of Rs. 2246.29 due to mortality and reduced egg production.

References

Alders, R.G., S. Inoue and J.C. Katongo, 1994. Prevalence and evaluation of hitchner B1 and V4 vaccines for the control of newcastle disease in village chickens in Zambia. Preventive Vet. Med., 21: 125-132.

Bhatti, B.M., 1989. Incidence of poultry diseases and the importance on poultry production in Pakistan. Pak. Vet. J., 9: 194-197.

Gail, D., 1994. Newcastle disease. The Chicken Health Handbook, USA., pp: 125.

Rehmani, S.F. and S. Firdous, 1995. Passive immunity in chicks from a laying flock vaccinated with the Mukteswar strain of Newcastle disease virus. Preventive Vet. Med., 23: 111-118.

Saidu, L., R.I.S. Agbebe and A.P. Abdu, 1993. Prevalence of avian spirochaetosis in zaire, Nigeria. Isreal J. Vet. Med., 48: 190-191.

Thitisak, W., O. Janviriyasopak, R.S. MorrSrihhankim and S. Sihakim, 1989. A poulty health and productivity pro file-disease and control measures. Proceedings of the International Seminar on Animal Health and Production Services for Village Livestock, August 2-9, 1989, Khon Kaen, Thailand, pp: 409-415.

Wonnacott, R.J. and T.H. Wonnacott, 1985. Introductory Statistics. 4th Edn., John Wiley and Sons, New York, Pages: 450.