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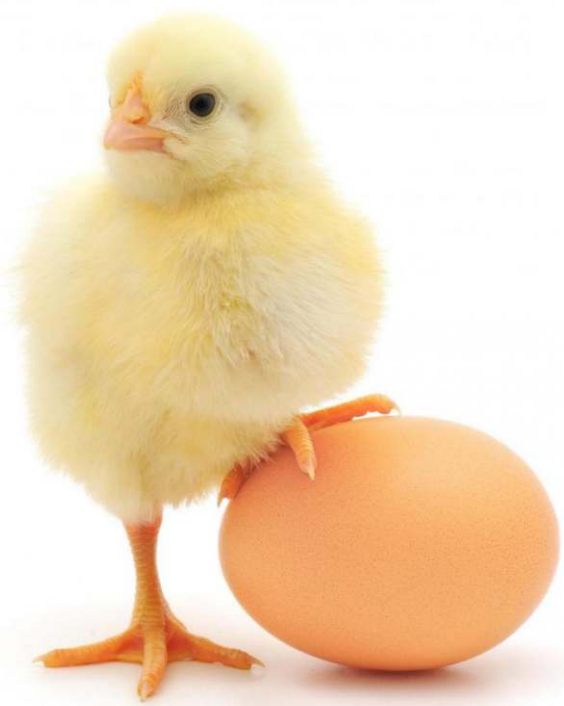

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ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

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Eco-Epidemiologic Impacts of HPAI on Avian and Human Health in Egypt

H.A. Kaoud
Department of Veterinary Hygiene, Faculty of Veterinary Medicine, Cairo University, Egypt

Abstract: In this article, trials for investigation and analysis were carried out to understand the ecological and the epidemiological aspects of AI problem in Egypt and its impacts on poultry and human health.135 different flock types (Broilers, Breeders, Layers, Ducks and Geese) as well as Roof-top and Back-yard raising birds from 18 different Governorates of Egypt were examined serologically for detection of AI antibodies during the period from Feb. 6th, 2005 to Feb. 6th, 2006. Farm and Governorate biosecurity measurers were analyzed and evaluated besides, the impacts of HPAI on human health. The results showed that AI virus antibodies were detected in roof-top and back-yard raising birds only (Fowls, Ducksand Geese) in percentages averaged 4%,10% and 2% in (EL Qualiobia, EL Dakahlia, Dimiatta, Cairo and Giza) (EL Qualiobia, EL Dakahlia, Dimiatta, Cairo, Giza EL Menia, Beni-Seuif and Kafer EL Sheikh) and (EL Qualiobia and EL Behaira) respectively. The association between the biosecurity of the farms and the occurrence of AI infection during the epidemic strike, revealed: 3.76 relative risk, 0.69 attributable risk, 2.66 The association between governorates farm density and the occurrence of AI infection revealed: 1.29 relative risk, 0.15 attributable risk, 1.55 Omega magnitude and Ψ was 1.88. The impact of AI on human health in Egypt was analyzed through a retrospective study and a zoonotic epidemiological map was drew.

Key words: Health impacts, biosecurity failure, roof-top and back-yard birds, retrospective, case-fatality

Introduction

Avian influenza (AI) viruses are a diverse group. Experimentally; HPAI viruses typically produce a similar severe, systemic disease with high mortality in chickens and other gallinaceous birds. However, these same viruses usually produce no clinical signs of infection or only mild disease in domestic ducks and wild birds (Spackman *et al.,* 2002, Boender *et al.,* 2007 Swayne, 2007) with possible public health implications (Munster *et al.,* 2005).

Sporadic human infections have been reported with a few select avian influenza (AI) viruses over the past 50 years. Most of the infections resulted from the H7N7 high pathogenicity AI (HPAI) virus from Netherlands (2003) and H5N1 HPAI viruses from several Asian countries (1997-2005). Epidemiological studies have identified direct exposure to infected poultry as the primary risk factor for human infection. (Swayne, 2007). In May 1997 a virus of H5N1 subtype was isolated from a young child who died in Hong Kong and by December, 1997 the same virus was confirmed by isolation to have infected 18 people, six of whom died (Shortridge, 1999). Until May, 2006, the WHO estimate of the number of human to human transmission had been "two or three cases" (McNeil, 2006). The latest estimation made by WHO (2006) was 348 human infections and 215 deaths and from this number 43 human infections and 19 deaths in Egypt.

Lack in the application of biosecurity programs at the both levels in Farms and Governorates, absence of strict banning for poultry and their products between the different districts and Governorates of high poultry - dense areas as well as lack in the veterinary public health culture were; and still the most important contributing risk factors for the spread of HPAI epidemic and human infection in Egypt (Kaoud, 2007).

In this article we try to understand the ecological and the epidemiological aspects of this complicated problem in poultry and human health in Egypt.

Materials and Methods

Screening of al antibodies in serum: Investigation of the presence of HPAI (H5) virus during the period from February, 6, 2005 to February, 6, 2006 in Egyptian Governorates through the detection of AI serum antibodies in poultry flocks and roof-top and back-yard birds (Unpublished data). AN ENZYME - LINKED IMMUNOSORBENT ASSAY (Commercial Biocheck ELIZA Kits) was used. The screening was carried out through: ELIZA Kits which were initially used to screen sera from poultry farm flocks (135 different flocks of Broilers (50), Layers (50), Breeders (45), Ducks (40) and Geese (20) with total serum samples (3775) as well as roof-top and back-yard raising birds) Fowls(500), Ducks (250), Geese (250) and Pigeon (150) with total serum samples (1159) were examined for detection of AI antibodies. EL Behaira, EL Sharkia, Cairo, EL Giza, EL Monofia, EL Qualiobia, EL Dakahlia, Dimiatta, EL Ismailia, EL Gharbia, Kafer EL Sheikh, South Sinai, EL Sues, Port Sied, EL Fayum, EL Menia, Aswan and Benisuif were investigated.

Detection of H5 AI antibodies: Positive serum samples of ELIZA for AI antibodies were tested for the detection of H5 AI antibodies by using AG-STRIP H5 AI.

Evaluation for the biosecurity measures:

1. Have been taken during the outbreaks in the affected farms.
2. Have been taken during the Egyptian outbreaks in the Governorates.

Retrospective study as a case - control study: Based on analysis of human cases. The analysis included all laboratory-confirmed human cases of H5N1 infection as reported by Ministry of Health .All positive cases were confirmed by PCR and by Micro neutralization assay on serum specimens.
Trial to draw a zoonotic AI map in the Governorates from the obtained data.

Analysis and calculations

Biosecurity evaluation: Biosecurity was evaluated and analyzed according to, Tablante *et al.* (2002) and Kaoud (2007) through Biosecurity parameters and their scores in the poultry farms

Biosecurity parameters	Score (code)
1. Self proofing (bird and house)	(yes = 0.1, no = 0)
2. Rodent and wild bird proofing	(yes = 0.1, no = 0)
3. Ventilation area	(yes = 0.1, no = 0)
4. Adequate distance between farms and other poultry operations	(yes = 0.1, no = 0)
5. Hygienic disposable of carcass	(yes = 0.1, no = 0)
6. Self sufficient (farm equipment)	(yes = 0.1, no = 0)
7. Cleaning and disinfection	(yes = 0.1, no = 0)
8. Foot dips	(yes = 0.1, no = 0)
9. Traffic control	(yes = 0.1, no = 0)
10.Visitor restriction	(yes = 0.1, no = 0)

Biosecurity failure as a risk factor:

Biosecurity Level	AI Infection Present	Absent
Exposed	A	B
Non -exposed	C	D

Relative Risk:

$$\text{R.R.} = \frac{\frac{A}{A+B}}{\frac{C}{C+D}}, \quad \text{Attributable Risk} = \frac{A}{A+B} - \frac{C}{C+D},$$

$$\text{Omega} = \frac{A+C}{B+D}, \quad \text{The odd ratio } (\Psi) = \frac{A \times D}{B \times C}$$

Results and Discussion

Ecology and epidemiology of HPAI epidemic in Egypt: Table 1 shows the incidence of AI virus (at the period from 6/01/2005 to 6/02/2006) among different poultry flocks and roof-tap and back-yard birds in the examined Governorates of Egypt. (EL Behaira, EL Sharkia, Cairo, EL Giza, EL Monofia, EL Qualiobia, EL Dakahlia, Dimiatta, EL Ismailia, EL Gharbia, Kafer EL Sheikh, South Sinai, EL Sues, Port Sied, EL Fayum, EL Menia, Aswan and Benisuif) . We failed to detect AI antibodies in serum samples in Broilers, Layers, Breeders, Ducks and Geese flocks of poultry farms during the period of survey (06/4/2005 to 06/2/2006). While the average percentages (incidence) of AI virus antibodies among roof-top and back-yard raising birds in the different 18 Governorates of Egypt (Fowls, Ducks, Geese and Pigeons)were 4%, 10%, 2% and 0% respectively as follows:

1. EL Qualiobia, EL Dakahlia, Dimiatta, Cairo and Giza.
2. EL Qualiobia, EL Dakahlia, Dimiatta, Cairo, Giza EL Menia, Beni-Seuif and Kafer EL Sheikh
3. EL Qualiobia and EL Behaira.

Table 1: Shows the incidence of AI virus among 18 different Governorates of Egypt.

Species	Number of flocks	Number of Samples	Positive Samples No.	%
Farms	50	2500	0	0.0
Broilers	50	1225	0	0.0
Layers-Breeders	25	500	0	0.0
Ducks	40	300	0	0.0
Geese	20	250	0	0.0
Total	185	3775	0	0.0
Roof-tops				
Fowls[1]		500	20	4.0%
Ducks[2]		250	25	10.0%
Geese[3]		250	5	2.0%
Pigeons		150	0	0.0%
Total		1159	50	4.0%

1: EL Qualiobia, EL Dakahlia, Dimiatta, Cairo and Giza (6%, 3.5%, 3.5%, 3% and 4% respectively). 2: ELQualiobia, EL Dakahlia, Dimiatta, Cairo, Giza EL Menia, Benisuif and Kafer EL Sheikh. (15%, 10%, 12%, 9%, 8%, 8%, 8%and 10% respectively). 3: EL Qualiobia and EL Behaira. (2% for both).

AI viruses have been isolated sporadically from domestic poultry, most frequently chickens, turkeys and ducks and captive wild birds held as caged pets, or in quarantine stations, private collections and zoological parks (Alexander, 1993). Our results agreed with those reported by Ahmed (2006) who isolated AI H5N1 for the first time in Egypt from backyard cases in ducks and geese during the period of 12/2/2005 to 14/2/2006 in 3 Governorates (Cairo, Qualiobia and Giza). We suggest that, AI virus (H5N1) just disseminated in a narrow scale through migratory birds then exhibit varying degrees of adaptation to individual host species of rooftops, which considered as a mixing pool with frequent and easy interspecies transmission. And due to the direct contact between roof-top birds and wild birds, in turn these wild birds transmitted the virus every where. Our suggestion in agree with Hinshaw *et al.* (1985); Swayne *et al.* 2007; Panigrahy *et al.* (2002) and Choi *et al.* (2005).
Brugh and Johnson (1987) suggested airborne transmission may have a limited role in inter-flock dissemination of AI virus as compared to mechanical movement of fomites on equipment, clothing, or shoes.

Table 2: The association between the presence of biosecurity failure and the occurrence of AI infection in poultry farms (In the 26 Governorates)

Risk factor	Infection	No infection	
Exposure (presence of risk factor)	A: Number of farms = 837	B: Number of farms = 52	889
Not-exposure (absence of risk factor)	C: Number of farms = 100	D: Number of farms = 300	400
	937	325	1289

Table 3: The association between the presence of biosecurity failure and the occurrence of AI infection in the 26 Governorates

Governorates Parameters	Sharkia	Qualiobia	Giza	Aveerage of 4 Governorates
No. of affected farms	267.0	183.0	107.0	5.00
G. biosecurity measures	0.3	0.3	0.5	0.80
Farm\square Km. (average).	4.0	4.0	1.0	0.25
Traffic activity	4.0	4.0	3.0	1.00
Back-yards	80.0%	75.0%	40.0%	10.0%

Table 4: The association between poultry farm-density (Number of farms\sq. Km) and probability of infection spreading

Risk factor	Infection		No infection		
Exposure(high density (4/sq.Km)	A: Number of farms =	558	B: Number of farms =	287	845
Not-exposed (0.5/sq. Km).	C: Number of farms =	226	D: Number of farms =	218	444
		784		325	1289

Relative Risk = 1.29. Attributable Risk = 0. 15, 'Ω = 1.55, Ψ = 1.88

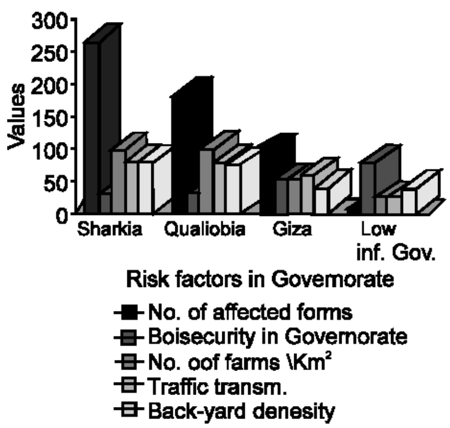

Fig. 1: Potential risk factos of transmission

Wild birds may play a major role in initial introduction of AI viruses in domestic poultry, but once established or adapted in commercial poultry, have had a very limited or no role in secondary dissemination (Hinshaw,*et al.*, 1986; Nettles,*et al.*, 1985). Most outbreaks have been occurred from epizootics of HP and MPAI in commercially raised poultry in back-yard and live poultry markets in the developing countries (Shortridge, 1999).

Biosecurity evaluation:

Biosecurity failure and the occurrence of AI infection in poultry farms (In 26 Governorates): Table 2 revealed that, there was a powerful association between the applied biosecurity measures of the farms and the occurrence of AI infection, where the relative risk for the occurrence of the disease was 3.76 and the magnitude of this association was 0.69 (attributable risk) i.e.69 % of epidemic cases that occurred probably owing to biosecurity failure in the affected poultry farms. On the other hand, Omega magnitude was 2.66 i.e. the probability of infection would be greatly reduced in the presence of good biosecurity measures.

Biosecurity is defined as a set of management, which reduces the introduction and spread of disease causing micro-organism into and between sites, so the biosecurity procedures should be combined with disinfection, sanitation, vaccination and strategic treatment to eradicate or reduce these pathogens to non infectious levels (Kaoud ,1999; Smith, 2002; Tablante *et al.,* 2002; Mandel *et al.,* 2005).

Biosecurity failure and the occurrence of AI infection in the 26 Governorates: ELSharkia, EL Qualiobia and Giza Governorates had high incidence of infection this could be explained by the absence of satisfactory biosecurity measures that should have been taken during the epidemic it. The findings can be illustrated the situation as follows:

Infection was strongly increased in spreading:

1. In districts and Governorates of high density in poultry farms (heavy character) as in case of Qualubia and ELSharkia Governorates.
2 It was probable that the infection strongly decreased in Governorates of low density in poultry farms as in case of Quena, Aswan and Sohage - Governorates.

Potential risk factors of transmission were of high magnitude during the outbreaks in ELSharkia, ELQualubia and EL Giza Governorates.

Table 4 declared that, there was an association between poultry farm-density (Number of farms/Km^2) and probability of infection spreading. The relative risk was 1.29, this means that there was an association between this risk factor and the spreading of AI infection .The magnitude of this factor ‘attributable risk” was 0.15 i.e.

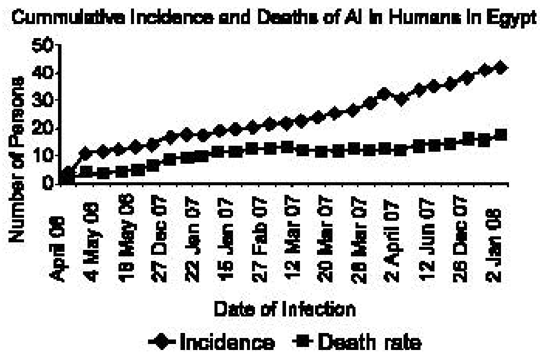

Fig. 2: Cumulative incidence case-fatality rate in Egypt, up to January 2nd, 2008.

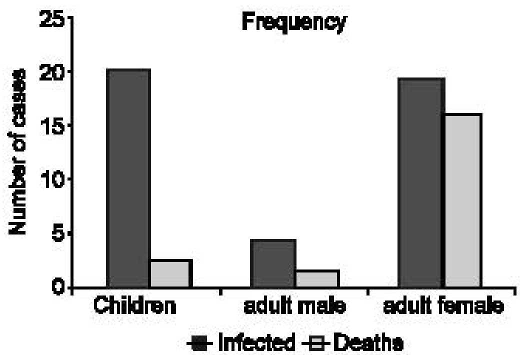

Fig. 3: Age specific incidence and age specific case fatality.

there is a probability for the acceleration of AI spreading in a percentage of 15%. Psi (Ψ) was 1.88 i.e. the chance for epidemic occurrence was approximately 2 times greater in the presence of heavy density-farm regions than of low regions (A heavy density-farm region could be presumed a risk factor during spreading of epidemic). In Italy, where an outbreak of HPAI H7N1 virus spread quickly and extensively and could be controlled only by the depopulation of nearly all flocks in the affected area of 5500 km^2 (Alexander, 2000; Thompson *et al.*, 2002).

Retrospective study as a case-control study: Based on analysis of human cases: Analysis of all laboratory-confirmed human cases of H5N1 infection.

Cumulative incidence (Fig. 2): The overall cases of infection in Egypt , up to January 2nd, 2008 is 12.64% (64 Persons) in relation to overall reported cases in the world (348 Persons).The curve of the cumulative incident human H5 N1 cases shows 3 peaked during the period from March 25th ,2006 to January, 2nd, 2008.

Case-fatality rate (Fig. 2): The overall case fatality rate, up to January 2nd, 2008 is 43% (19/43) in relation to the reported cases in Egypt and 8.84% in relation to overall reported cases in the world (61.18%).

Age specific incidence (Fig. 3): The age specific incidence appears not constant across the age group, in

The possibility of applying the obtained data to draw a Zoonotic epidemiological map.

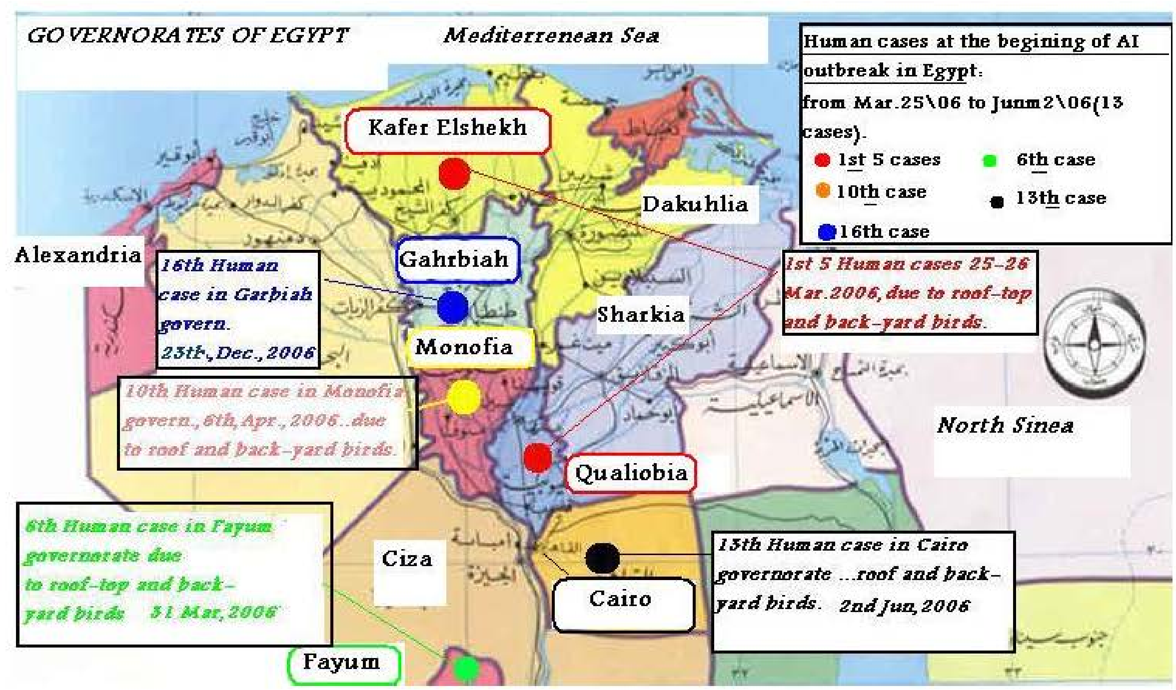

Fig. 4: Emerging of human cases in the Epidemic HPAI in Egypt

children and women is high but very low in men. In children is 46.51%, women 48.84 and in men 4.65%.

Age specific case fatality (Fig. 3): Case fatality in women is very high on contrary to children and men where it is 84.20%, 10.53% and 5.27% respectively. From the occupational point of view, 95.35% of deaths are due to the close contact between house-keeper women and roof-top and back-yard birds. In Indonesia, the age specific incidence rate across the age groups is relatively constant up to the age of 30 and then declines among those who are older. In Viet Nam, the age - specific incidence rate appears relatively constant across the age group of 40 (WHO, 2006).

Owing to the two serious points:

1 The number of human cases is increasing dramatically in parallel to the extension of outbreaks among avian farms and back-yard birds.

2 The dilemma of roof-top & back-yard birds, active poultry transportation,biosecurity failure and lake of efficient vaccination program still exist. It is hoped that action based on these results, observations and measurements will contribute to approach:

a Adequate and experienced vaccination protocol should be applied immediately against the dramatic extension of HPAI endemisity in Egypt.

b Policy of stamping out should be considered as a possible tool to prevent the long term infection of the disease in certain high-risk areas.

c Our results indicate that outbreaks of HPAI are difficult- if not impossible-to control with usual measures in poultry-dense areas and with unsolved back-yard problem as well as roof-top dilemma.

d Restrict biosecurity measures should be applied and activated at Farm and National levels.

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